Developing an Agile Supply Chain Model for SMEs

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Sean Hugh Naughton

School of Management

Faculty of Humanities and Social Sciences

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ABSTRACT

Rising worldwide competition is making it increasingly difficult for SME organisations to compete in the marketplace as traditional means of manufacture, and modes of delivery are being changed through technological advancements. In line with these factors, organisations are ever more capable of producing goods that are more bespoke and personalised than in the past and within the price ranges and affordability levels of demanding markets. Whilst large organisations have the power to enforce supply chain compliance in order to meet these changes, it is not always the case for SMEs.

The agile supply chain philosophy moves away from traditional methods under which large organisations enforce supply chain compliance, and embraces the concept of supply chain agility that allows the supply chain as a whole to move forward *as one* and share the benefits as a developed and cohesive unit. Such a philosophy should be to the advantage of all organisations, but ought to be of particular interest to SMEs as its use could assist in improving their competitiveness.

This thesis is primarily concerned with the development of agile supply chains within SME organisations. The research sets out to develop the means through which SMEs can develop their agile supply chains so as to make them more efficient and competitive both now and in the future. The research is set upon existing theories and models, particularly following the works of Sharifi *et al.* (2006), Ismail and Sharifi (2006), Ismail *et al*., (2006) and Ismail *et al*., (2011) so as to contribute further to their concepts theoretically and to also present the practical means by which such frameworks can be utilised in industry. The research provides a link between manager perceptions and underlying factors that affect their organisations and how they relate to the markets served. This has been achieved through the development of a model through which SMEs can analyse their present operating position, consider new product features, potential supply chain partners and the means through which to develop their agile supply chains as a complete unit.

Using case study methodology, some extensive fieldwork has been undertaken to examine the ideas and extend our understanding of the approaches to build and sustain agile networks for organisations introducing products into markets. The study has assisted in reforming and developing the initial models into practical tools. Further to this, the research offers a series of developmental roadmaps that can be followed by SMEs to assist in the progress of developing agility into their supply chains.

The outcomes from the research provide a contribution to academic theory and practice and build upon previous research, taking it forward with practical tools that organisations can utilise. The findings provide evidence for the benefits that can be derived from the developed models such that their application could be realistically considered within a practical setting.

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LIST OF ABBREVIATIONS

1. ARM – Agility Road Map
2. B2B - Business to Business
3. B2C - Business to Customer
4. ERP – Enterprise Resource Planning
5. IDEF0 - Integration Definition for Function Modelling
6. ISM – Integrated Supplier Management
7. JIT – Just in Time
8. MNC – Multinational Corporation
9. MNE – Multinational Enterprise
10. MRP - Material Requirements Planning
11. MRPII - Manufacturing Resources Planning
12. OM - Operations Management
13. PFS – Present Functioning State
14. SADT - Structured Analysis and Design Technique
15. SCOR - Supply Chain Operations Reference Model
16. SCM - Supply Chain Management
17. SME - Small and Medium Sized Enterprises
18. TQM – Total Quality Management

1.0 Introduction

This chapter introduces the research presented within this thesis, which is concerned with developing agile supply chains within SMEs (Small and Medium Sized Enterprises). Included within the chapter are overviews of the research background, motivation, aims and the thesis structure.

1.1 Change and Uncertainty in the Global Business Environment

Whilst the business environment has always operated in a state of change, the commercial setting over the past few decades has profoundly changed with technology, customer demands and market environments altering the ways of life for many (Vázquez-Bustelo *et al*., 2007). Subsequently, businesses have had to adapt to operating in increasingly competitive global markets (Kumar and Sosnoski, 2011), complicated further by augmented levels of exposure to uncertainty (Bernardes and Hanna, 2009; Demmer *et al*., 2011; Sharifi *et al*., 2013).

Whilst changes in technology, customer demands and market environments may now be anticipated and considered unexceptional *per se*, issues such as the 2008 financial crisis (Christopher and Holweg, 2011) and the 2011 Japanese earthquake (Wieland and Wallenburg, 2012) complicate this already turbulent environment further. According to Mitroff (2004) and Ingirige *et al*., (2008), such extreme situations are becoming more frequent. Accepting this backdrop to the business world of today requires organisations to carefully consider the risks and positions they hold in line with the strategies they choose to take (Nath *et al*., 2010). The practical complexities organisations work within are multidimensional and not without challenges (Fixson, 2004), and businesses have become increasingly flexible in order to meet such demands (Ismail *et al*., 2006).

The situation confronting business in general is significant, but due to their restricted means, the challenge facing SMEs is greater (Ahmad *et al.,* 2012). Technological advances and on-line shopping have seen SMEs encounter increases in competition hitherto never experienced, and limited research in the SME field (Gligor *et al.,* 2013) has not assisted the matter. Thus, the impacts associated with global change to businesses and SMEs in particular are considerable and arguably worthy of detailed research and consideration.

1.2 Strategies in Response to Uncertainties: The Agility Concept

Due to the changing market and operating environments, it has become apparent that organisations need to be able to adapt to change and uncertainty at short notice. To address this notion, theories and concepts have been put forth, particularly in the manufacturing sector, starting in the 1970s. Arguably, these concepts were initially centred on the prospects of lean production and quality (Womack and Jones, 1996). Such models provided adopting organisations with some degree of success but researchers such as Chen (2001) found these manufacturing methods to be less beneficial than might otherwise have been assumed.

In the early 1990s, the agility concept was introduced by the Iacocca Institute at Lehigh University and was proffered by Nagel and Dove (1991) and subsequently by Goldman *et al.,* (1994), Dove (1995), Kidd (1995), Sharifi and Zhang (1999) and Ismail *et al*., (2006). The Iacocca Institute's work suggested US-based manufacturing should change track from mass-production to agile manufacturing structures to be able to rapidly alter the components and goods under production to meet customer demands at short notice. It was further argued that through this process the advances created by international competitors would be reduced (Nagel and Dove, 1991).

The agility concept came to represent the ability of organisations to reliably manufacture efficiently at low costs and high quality to meet customer demands quickly within unpredictable world markets (Christopher, 2000). Whilst the concept was first established to improve US-manufacturing, its significance on an international scale should not be underestimated, with some authors arguing that the concept's importance is such that non-agile organisations unable respond proactively to unforeseen, unanticipated events and prospects will not survive in the future (Vinodh *et al*., 2009).

Throughout its development timeframe, some publications have suggested the agility concept as being the capability of an organisation to respond to the changes brought about by the business environment and customers, whilst others regard it as more of an organisational strategy that can help in attaining competitive advantage. Ismail *et al*., (2011) believe the concept evolved as a means of helping organisations function in unstable environments to support them in being proactive rather than responsive to the situations being experienced in the marketplace.

The agility concept has been extended to other sectors and dimensions of industry including the IT and service sectors (Sarker *et al*., 2009), supply chain management (Gligor and Holcomb, 2012a), and SMEs (Ismail *et al.,* 2011). These will be reviewed in the literature review chapter.

1.3 Agile Supply Chains: an Extension to the Agility Concept

According to Sharifi *et al*., (2006) two significant issues arose within Operations Management and business in general in the 1990's. The first was based around the matters of change and uncertainty as previously considered (Nagel and Dove, 1991; Goldman *et al.,* 1994; Dove, 1995; Kidd, 1995; Cho *et al.,* 1996; Fliedner and Vokura, 1997; Sharifi and Zhang, 1999). The second was based around the changing competitiveness of world markets resulting in supply chains being seen by organisations as units of analysis and therefore key elements of their competitive strategy (Goldman *et al.,* 1994; Christopher, 1998).

The very nature of the market changes experienced resulted in organisational reliance upon others to supply specialised resources (Ferdows, 2008) from different parts of the globe to minimise costs and augment market opportunities (Zhang and Gregory, 2011; Asmussen and Wæhrens, 2015). Associated with such reliance is the increased risk of supply chain interruption and disturbance (Christopher and Holweg, 2011), which along with the technological market changes considered earlier in this chapter (Vázquez-Bustelo *et al*., 2007) presents a situation whereby supply chains are becoming increasingly vulnerable to disruption which in turn could threaten the livelihood of the organisations therein (Christopher and Holweg, 2011). Whilst historically organisations have made allowance for supply chain disturbances through managing relationships, locations and the ways through which products are manufactured, this is not always possible and the risks pose ever-greater challenges – particularly for SME organisations (Kotha *et al*., 2013).

Building upon the need for proactivity highlighted earlier in this chapter, arguments have been made to establish greater levels of supply chain resilience. Pettit *et al*., (2010) in Asmussen and Wæhrens (2015) suggest that supply chain resilience requires the ability to avoid disruption, diminish the effects of disruption that may occur, and make changes for future disruption. Following this, Wieland and Wallenburg (2013) suggest that supply chain resilience requires both robustness and agility. Whilst robustness is concerned with opposing change such that the supply chain can cope with it, agility is interested in adapting to the changes as they occur through reconfiguring the supply chain in line with needs at the time (Asmussen and Wæhrens (2015). It is the latter of the two requirements that is of particular interest in this thesis. Accordingly, attention will now turn to supply chain agility.

The drivers behind agile supply chains are change and uncertainty, further exacerbated with extended supply chains (Svensson, 2000), resulting in the need for organisations to be responsive in the ways they operate (Christopher and Towill, 2000). Researchers have considered the subject extensively and offered

definitions since the early 1990s (for example the Iacocca Institute, 1991; Christopher, 2000; Amir, 2011; Abbasi *et al.,* 2014).

Whilst the characteristics and benefits of agile supply chains have been considered from a broad-range perspective, empirical studies have been carried out to examine their effects (Vickery *et al*., 2010; Blome *et al*., 2013). The results reported suggest that supply chain agility can provide organisations with performance improvements (Christopher, 2000; Gligor and Holcomb, 2012), thus enabling them to better align supply and demand within the markets in which they operate (Christopher, 2000).

From a theoretical perspective, the agile supply chain concept has received a fair amount of attention. However, from the standpoint of an emerging methodology that can set organisational strategy and direction, it has not been developed well as a practical supportive method or tool. As projected by Vázquez-Bustelo *et al*., (2007) there is a lack of tools available to assist in agile supply chain development and implementation, which is potentially damaging. Zhang (2011) and Ismail *et al.,* (2011) have also highlighted that there is no satisfactory answer to the question as to how agility can be built into organisations, and particularly across supply chains.

As noted earlier in this chapter, the defining context of the agility concept addresses the very broad ranging needs of organisations working within constantly changing markets (Goldman *et al*., 1994). Yet considering uncertainty as the underlining condition defining the business environment (Gligor and Holcomb, 2012) may be perceived as contradictory to the idea of setting formalised procedures for developing and implementing the traditional model approaches generally advocated within Operations Management (van Hoek *et al*., 2001).

There are therefore gaps, both cognitively and practically, between the conceptual definitions of agility and the means through which to bring it about into a functioning model that can assist organisations – in the case of this thesis, for SMEs in particular (Ismail *et al.,* 2011).

1.4 SMEs and Sustained Competitiveness under Uncertainty

The discussions so far have been reasonably broad with respect to the effects experienced by organisations as a whole. Yet in considering the changing business environments, it is necessary to differentiate between the operational sizes of the organisations therein, and for this thesis SMEs in particular. SMEs (Small and Medium Sized enterprises) are recognised as being a major contributor to employment (Ismail *et al.,* 2011) incorporating approximately 90% of businesses in European and developed Western economies (Bennett, 2008). According to Sullivan-Taylor and Branicki (2011), 99.9% of UK businesses are SMEs, constituting almost 60% of private sector employment, yet on average they employ less than 250 people with annual turnovers of 50 million euros or less, thus emphasising their vulnerabilities further.

The importance of SMEs and their significance in the marketplace and financial importance within the broader economic setting cannot therefore be overestimated (Ates and Bititci, 2011). In spite of their large numbers and importance throughout the world, SMEs are deemed to be predisposed to the vulnerabilities associated with change and competition (Gunasekaran *et al.,* 2011). Whilst successful SMEs have historically been resilient when utilising market-oriented approaches to their businesses (Salavou *et al*., 2004), they are increasingly facing competition from not only traditional sources but also international organisations willing to supply via internet-based sales, taking advantage of fluctuating international economic situations (Gunasekaran *et al.,* 2011).

As well as market fluctuations and the challenges faced therein, SMEs also have to deal with threats emanating from the supply chains with which they interact. Such interferences impact significantly upon costs and affordability (Hendricks and Singhal, 2005) leading to high levels of vulnerability for the organisations concerned (Thun *et al*., 2011). Accordingly, SMEs face a special set of operating conditions due to the limited resources and funds at their disposal (Bhamra and Dani, 2011) including financial, legislative, supply chain-based, fluctuating customer requirements and technological circumstances that are not experienced in the same way by larger organisations. Complicating matters further are issues such as the 2008 financial crisis (Christopher and Holweg, 2011), which have amassed additional stresses upon SMEs in terms of their costs and competitiveness (Ismail *et al*., 2011).

These arguments point to the need for extended research on agility and agile supply chains, and more importantly due to their significance in the future of economies (Radam *et al.,* 2008; Peters and Waterman, 2012), on developing effective approaches for introducing and implementing agile supply chains into SMEs. This particular point is strongly argued by Ismail *et al*., (2011) who advocate that due to the nature and adaptable ways in which SMEs naturally function, it is rational to adopt the agility

concept. Accordingly, there is a logical and significant need for SMEs to develop agile supply chains to contribute to their competitiveness.

As previously highlighted, the majority of the existing work on agile supply chains has been developed around larger firms and extending these studies to SMEs cannot be theoretically supported. While there have been some initial works to open this discussion (for example, Ismail *et al., 2006*), the need for extending this line of research is followed by this study. Theoretically and practically there are key questions to address in undertaking such work, and they are outlined in the following section.

1.5 The Rationale and Key Agenda for the Research

Having highlighted the changing world economic issues businesses in general face, and the supposition that agility and agile supply chains can assist them in their challenges, it is reasonable to consider the proposition that the concepts are applicable to and can benefit SMEs. Arguably, their smaller stature and additional vulnerability (aligned to their economic significance) might suggest the need for the application of such concepts to be greater for SMEs than their larger counterparts. Despite this situation, the lack of research and practical tools available to assist SMEs in the development of their agile supply chains is stark (Jain *et al.,* 2008; Vinodh and Prasanna, 2011; Sangari *et al.,* 2015). Furthermore, the theories and models that are available are fragmented and yet to be substantiated within SMEs (Eckstein *et al.,* 2015).

The starting point for this research therefore is the acknowledgement of the lack of tools available for SME agile supply chain development, and the need to extend the line of research in this area and develop an effective approach to introduce and implement agile supply chains into SME organisations. The investigation is underpinned by the work conducted in the UK by Ismail and Sharifi (2006), Sharifi *et al.,* (2009), Ismail *et al.,* (2011) and Sharifi *et al.,* (2013), and subsequently, aligned to these works, focuses on SMEs in the UK.

The agenda for this thesis therefore is based upon the key points highlighted previously on agility and agile supply chains considered in the context of SMEs. Incorporating SMEs into the argument and considering their standpoints and needs in more depth presents a challenging prospect for this sector in taking up and implementing agility and agile supply chains, as partially addressed by Ismail *et al*., (2011). The opportunity for this research is to further understand how SMEs can achieve sustained competitiveness mainly with regards to product innovation, production and their supply chains. The pragmatic question should therefore be based upon how SMEs should and can engage in product

innovation and development in accordance with the circumstances of their business environment to consequently, successfully and sustainably deliver their products to markets and customers around the world, with the supply chain as the unit of analysis. To take this agenda forward and develop this thesis, a series of key objectives have been set:

- **Objective 1 -** To theoretically and empirically explore the idea of agile supply chains in the context of SMEs. This will involve the exploration and extension of agile supply chain frameworks for SMEs, to examine their benefits or otherwise, and to ultimately test this through case studies.
- **Objective 2 -** To develop an integrated framework for agility and agile supply chains such that a methodology can be devised to assist SMEs in adopting agile supply chain approaches. This will be tested empirically through the use of case studies, which in turn will show how the offered model may assist strategic decision-making in SMEs. This strategic decision framework theoretically integrates three key dimensions including the firm, its supply chain and the products being innovated and developed.
- **Objective 3 -** To utilise and develop supporting tools to assist the strategic decision framework (simplified for use by SMEs). These will include qualitative tools and an approach to assist SMEs via a roadmap model.

1.6 Research Questions

Having considered the objectives of the research it is necessary to highlight the key questions the research will attend to:

1. How should agility and agile supply chains be defined and understood within the context of SMEs? The question will extend to the identification of existing integrated frameworks for resilience, agility and agile supply chains that might be considered for SME adoption.
2. What considerations are required to operationalise the concept and provide practice-oriented views to implement agile supply chains in SMEs? Subsequently, what supporting tool should be developed to assist SMEs in the development and management of their strategic decision making process?
3. How are such methods and tools perceived by SMEs (and their relevant supply chains)? This is a question of validating existing works and the proposed approaches in this work, and how they impact upon the sustained competitiveness of SMEs.

1.7 Research Method

The study follows a mixed approach to the research including:

- The conceptual development of ideas for the strategic adoption of agility by SMEs through a literature review and the presentation of an extended model following some recognised works. The suggested framework employs and develops practical tools for the enhanced processing and implementation of the strategies.
- A field study that undertakes case studies of SMEs to examine the concepts and frames of thinking presented, as well as the effectiveness of the developed practical tools.
- Extending the framework and accompanying tools to a roadmap for adoption and implementation of the approach using learning from the field of study.

1.8 Thesis Structure

This thesis has been written in clearly defined sections and is presented in eight chapters. Chapter 2 explores the literature associated with agility, supply chain agility, supply chains and SMEs, supply chain implementation frameworks, the establishment of product requirements, supply chain partners and roadmaps. It then highlights the research gap and its interrelation with this thesis.

Chapter 3 investigates the potential models and frameworks that might be considered in the research study and justification for the approach adopted following the materials considered in the literature review.

Chapter 4 discusses the rationale and adopted methodological approach behind the research, as well as explaining the methods of data collection and analysis, ethical implications and the ways in which these were conducted.

Chapter 5 presents the data findings obtained through the research, following which Chapter 6 provides a discussion in its evaluation.

Further to the data analysis and discussion, Chapter 7 presents the developed roadmap tool that can assist an SME in the progress of its agile supply chain. An example of the instrument is demonstrated therein explaining practically how it works. Chapter 8 concludes the research findings, affords

standpoints on its contribution to knowledge and practice and proposes some suggestions on areas for research in the future.

Further to these chapters a bibliography and appendices are presented.

2.0 Literature Review

This chapter reviews the literature based upon the concepts of agility, supply chain agility and SMEs.

Whilst the agility concept has been in existence since 1991 (Nagel and Dove, 1991), there is limited evidence of literature relating specifically to agile supply chains (Gligor *et al.,* 2013) and SMEs. To review the literature from a wider perspective, a comprehensive analysis of the agility concept has been made. The predominant outcome of this is a broad overview of the nature and benefits to be derived from agility and supply chain agility, with a focus on application in SMEs.

From one perspective the lack of literature relating to SMEs and agile supply chains proved to be a challenge. From another point of view it also provided a gap from which to move the research forward and subsequently drove the literature review into the avenues relating to supply chains, SMEs, the business environment and partnerships, as well as concepts and models underlying the present state of the art of the subject.

The literature considered incorporates the antecedents to and impact factors affecting agile supply chains, which are illustrated in Figure 2. 1.

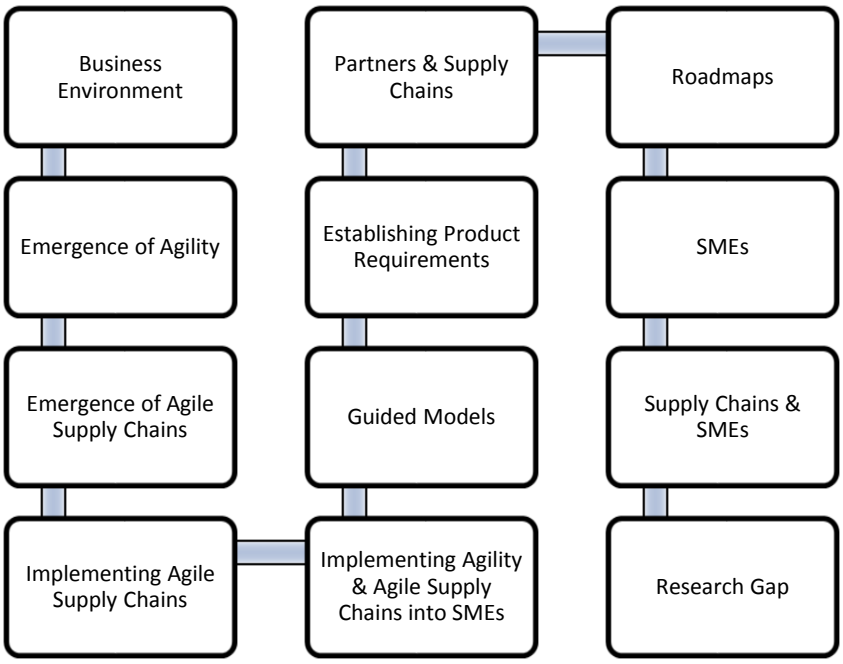


Figure 2. 1 - Overview of Areas Considered in Literature Review (Author)

2.1. The Business Environment – Setting the Scene for Agility

The business environment has changed over the last half-century, moving from a relatively stable world setting to one facing ever-challenging prospects. This environment is influenced by external factors incorporating economics, markets, marketing, customer demands and competition, as well as internal organisational factors including finance, risk, products and supply chains. Contributing to this change has been the rapid GDP growth rate in most western countries, resulting in an increase in consumer spending power (Manyika *et al.*, 2014). Such instability is not necessarily negative though - economic volatility is a driving force for organisational change and resultantly provides the momentum for organisations to meet best practice and responsiveness standards (Nickell *et al.,* 2001, Zarnowitz, 1985), thus improving their competitiveness within world markets. Resultantly, authors such as Venkatraman and Prescott (1990) argued that linking organisational strategies to the external environment as a whole leads to improved performance – a point more specifically supported by Hallavo (2015) who advocated the alignment of insecure, external environmental factors to supply chains to improve operational methods.

Whilst business environment changes have impacted upon most organisations, SMEs and their restricted means have possibly felt the challenge more than most (Ahmad *et al.,* 2012), with the financial tests faced (Löfving *et al.,* 2013) being compounded by legislature, market volatility, supply chain relationships and national economic failures (Bhamra and Dani 2011). Furthermore, the increase in world-wide competition and the now everyday use of on-line shopping has brought competition to SMEs that had hitherto not existed, making them more vulnerable to market fluctuations than their larger counterparts (Vargo and Seville, 2011).

This challenge is exacerbated further by the drive for improved quality and for new and innovative products from international customers placing SMEs in the position of having to compete more directly against larger organisations. SMEs do hold some advantages in this arena though in terms of reduced bureaucracy and their ability to adapt quickly (Sullivan-Taylor and Branicki, 2011), yet only limited research has been conducted to consider this, the outcomes from most of which appear not suitable for SME use (Herbane, 2010).

These challenges, aligned with technology and fluctuating, interlinked international market environments have altered the ways of life for many (Vázquez-Bustelo *et al*., 2007) resulting in the need for businesses and their supply chains to adapt to this new setting. Resultantly, due to the changing nature of industry (Calantone *et al*., 2003) and intensifying business competition (Kalkan, 2008), Hassler (2004) argued for the development of efficient supply chains to ensure organisations remain

competitive. Lee (2004) explored the need for supply chains to adapt to markets and to subsequently identify trends, change supply networks and track econometric changes. Building on this, Gunasekaran and Ngai (2005) believed the economic factors of political stability, taxation, interest and inflation rates to have been given less significance than would be anticipated in the strategic design of supply chains, the availability of resources and their importance to agile supply chains as a whole. Platts and Song (2010) argued similarly, highlighting the need for careful financial consideration in supply chain development.

The conclusion that could be drawn from this argues for the close alignment of econometric and other business environmental factors with supply chains, a point supported by writers such as Luo and Zhao (2013) who contended that economic strategies play a significant role in organisational performance relative to operating conditions. Yet in considering these points it is surprising that economic markers and their effects on supply chains are areas of limited research (Kumar *et al.,* 2015). This is even more surprising given that supply chain anomalies affect external factors such as stock and share prices (Hendricks and Singhal, 2003) and that the business environment, business interactions and economic factors play a role in supply chain performance.

To help cope with such market challenges, adaptation models have taken the form of automation and economies of scale (Peaucelle, 2000), quality (Crosby, 1979; Deming, 1986; Juran, 1988), overseas outsourcing (Platts and Song, 2010) and lean production philosophies (Lucio, 2013). Whilst such models have their advantages, they function best at times of stable demand and continuous production (Naim *et al.,* 1999) - the antithesis of future market predictions, that suggest the need for changes to the supply chain to achieve maximum effect. In line with this, Lapide (2006) argued for use of demand management techniques in supply chains, a point supported by Barney (1991) and Gunasekaran and Ngai (2005) who considered demand management techniques to be necessary in managing volume changes and seasonal demand through pricing strategies and marketing incentives. Despite such arguments, there is little evidence of models to support demand management techniques in supply chain development (Ponis *et al*., 2013).

A more effective stance when dealing with unpredictable demand alongside customers requiring product variations comes from agile operations (Narasimhan and Das, 1999), providing the ability to react quickly to changes in demand (Christopher, 2000). Agile operations are therefore seen to hold more of a strategic stance than other production philosophies and help to create long-term supply chain goals rather than short-term perceived financial gains (Dwyer *et al.,* 1987), a point supported by Arend and Wisner (2005) who argued for organisations to adjust their supply chains from being cost to responsiveness driven.

2.2. The Emergence of Agility

Historically, various authors including Cooper (1984) suggested that successful organisations in the future would need to adapt to their business environments and become more flexible in order to succeed. Such predictions have come to pass with organisations working to usurp challengers whilst increasing their rates of product change. At the same time international markets have become ever more competitive and unpredictable – arguably never more so than in the last twenty years (Mehralian *et al.,* 2013). Writers such as Kotler and Caslione (2009) and Christopher and Holweg (2011) suggested that such rates of change will increase in the future, thus increasing the need for strategies to improve organisational competitiveness (Mehralian *et al.,* 2013). Rationally, overcoming such challenges requires a different way of thinking and operating for organisations to remain successful (Abbasi *et al.,* 2014).

This new operational stance became known as the concept of *agility* – a model seen by Gligor and Holcomb (2012a) as one of the most significant concepts in supply chain management. Agility requires organisations to be able to adapt to change and uncertainty at short notice and was originally developed by Nagel and Dove (1991) at the Iacocca Institute at Lehigh University with further work following by Goldman *et al.,* (1994), Dove (1995), Kidd (1995), Cho *et al.,* (1996), Fliedner and Vokura (1997), Sharifi and Zhang (1999) Ismail *et al*., (2006) and Babazadeh and Razmi (2012). The Iacocca Institute's work advocated a move from mass production to manufacture based upon meeting customer demands at short notice in competitive and changing markets. This became known as agile manufacturing (Nagel and Dove, 1991).

The need to develop agile manufacturing systems was brought about by the high levels of global competition, new volumes of available information for use in decision making (Cox, 1999), customers with increased demands and the development of new types of relationships emerging between organisations (Handfield and Nichols, 1998).

The initial consideration of agility by Nagel and Dove (1991) is significant as from this four key workable concepts have come about, illustrating the broader approach it takes compared to earlier Operations Management concepts (Ismail *et al.,* 2006):

a) Providing total solutions for customers
b) Controlling change and uncertainty
c) Support between members of the supply chain to improve competitiveness
d) Build an organisation that is knowledge-driven

Naylor *et al.,* (1999) built on this overview and acknowledged the volatile markets organisations operate in, advocating that through market knowledge and the development of virtual organisations, agility could allow businesses to take advantage of market situations, a point supported by Ameri and Patil (2012) and Pan and Nagi (2013). Gunasekaran and Ngai (2005) further proffered the point that agility could be used as a competitive tool to increase organisational share of the marketplace in such turbulent situations. Yauch (2011) went further and advocated agility's incorporation of customer satisfaction, reduced delivery times and the use of technology to assist organisational competitiveness. Hasani *et al.,* (2012) suggested agility should provide the ability to meet shifting customer demands through faster product design, manufacture and lower cost distribution.

The agility concept has been seen as a new way of approaching supply chain challenges (Pan and Nagi, 2013) and is somewhat different from other concepts such as lean production and efficiency, as it incorporates a broader operating and arguably more strategic perspective. To achieve agility, organisations are required to not only be knowledgeable about their own customers, but also their customers' customers as well as everyone else involved in the supply chain (Simchi-Levi *et al.,* 2002). Practically, it is the effective management of information that assists with organisational agile capabilities in such supply chains (Ngai *et al.,* 2011, Sangari and Razmi, 2015).

Since Nagel and Dove's (1991) initial publication, many lines of argument have been published that illustrate agreement as to the features and benefits of the agility concept. Whilst Forsythe (1997) saw it as a means under which a nation could advantageously work together, others such as Gunasekaran (1999), Christopher (2000), Zhang and Sharifi (2000), Christopher and Towill (2001), Yusuf *et al*. (2004), Lin *et al*. (2006), and Gligor and Holcomb (2012), see it as a strategy through which organisations can gain competitive advantage and achieve performance improvements. In order to do this, organisations must be able to respond to customer needs in competitive, turbulent, volatile and technologically changing markets (Gligor and Holcomb, 2012). Agile organisations therefore are those that can control uncertainty and change within their operating spheres (Dove, 1993; Goldman *et al*., 1994; Plonka, 1997; van Hoek *et al*., 2001; Sharifi and Zhang, 2001; Zhang and Sharifi, 2007; Pilbeam *et al*., 2012). As well as assisting the long-term survival of organisations, agility also provides benefits in terms of cost and operating performance (Eckstein *et al*., 2015).

Whilst the features and benefits of the agility concept have reached some levels of agreement, defining agility has proven to be challenging, with multiple authors offering their definition of the model. Table 2. 1 provides an overview of various highlighted definitions considered for the agility term since 1991. It is not intended that this table provides every defintion of agility. Moreover it illustrates the agility definition timeline, showing the differing viewpoints made by various authors over time. The basis for

Table 2. 1 comes from Agarwal *et al.,* (2007), Bernardes and Hannah (2009) and Rimiene (2011) – further additions have also been made to it to illustrate the extensive definitions proffered.

Table 2. 1 – Agility Definition Overview (Adapted from Agarwal et al., 2007, pp. 2; Bernardes and Hannah, 2009, pp. 35; Rimiene, 2011, pp. 894, with further definitions added)

Year	Agility Definition Overview	Author
1991	A system that shifts quickly among product models/lines, ideally in real time in order to respond to customer needs.	Nagel and Dove
1993	Use of technology and production methods that utilise speed and flexibility to attain agility.	Goldman and Nagel
1995	A change proficiency.	Dove
1995	Delivering value to customers being ready to change valuable human knowledge and skills and form virtual partnership.	Goldman *et al.*
1995	An agile corporation is a fast moving, adaptable and robust business enterprise capable of rapid reconfiguration in response to market opportunities.	Kidd
1995	Refers to an enterprise ability to accelerate the activities on the critical path, and is, therefore, a direct indicator of an enterprise's time based competitiveness.	Kumar & Motwani
1995	Ability of an organisation to quickly change the manufacture of different products.	Upton
1996	Capability to survive and prosper in a competitive environment of continuous and unpredictable changes by reacting quickly and effectively to changing markets, designed by customer designed products and services.	Cho *et al.*
1996	Ability for an organisation to prosper in on-going and unforeseen change.	Richards
1997	Ability to market successfully low cost, high-quality products with short lead times and in varying volumes that provide enhanced value to customers through customization.	Fliedner &Vokurka
1999	Ability of an organization to respond efficiently and effectively to both proactive and reactive needs and opportunities on the face of unpredictable and uncertain environment.	Dove
1999	Survival through fast response to customer driven products and services in changing market environments.	Gunasekaran
1999	The interface between an organisation and the market it serves, improving competitiveness and future business opportunities.	Katayama and Bennett

Year	Agility Definition Overview	Author
1999	Ability for fast response and successful change by an organisation	McGaughey
1999	Agility is required when demand is volatile and the customer requirements for variety are high.	Narasimhan and Das
1999	Using market knowledge and virtual corporation to exploit profitable opportunities in a volatile marketplace	Naylor *et al.*
1999	Involves not only responding to changing market conditions but exploiting and taking advantage of these changes as opportunities.	Sharifi & Zhang
1999	A successful exploration of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and knowledge management to provide customer driven products and services in a fast changing market environment.	Yusuf *et al.*
2000	Ability of an organization to respond rapidly to changes in demand both in terms of volume and variety.	Christopher
2000	Use of market knowledge and virtual organisation to take advantage of opportunities in an unpredictable market.	Mason-Jones *et al.*
2000	Ability to gain competitive advantage by quickly taking advantage of opportunities and responding accordingly to threats.	Meredith and Francis
2000	Ability for an organisation to prosper in a changing, unpredictable environment.	Rigby *et al.*
2000	The integration of supply chains to develop close customer and supplier relationships.	Tolone
2000	Ability for an organisation to deal with unanticipated change and to survive unanticipated business environment threats whilst at the same time taking advantage of opportunities.	Zhang and Sharifi
2001	Ability of a firm to excel simultaneously on operations capabilities of quality, delivery, flexibility and cost in a coordinated fashion.	Menor *et al.*
2001	A strategy based upon organisations prospering in volatile and changing environments and their subsequent response.	Sanchez and Nagi
2001	A crucial element for dealing with market turbulence. A management concept centred around responsiveness to dynamic and turbulent markets and customer demand.	Van Hoek *et al.*

Year	Agility Definition Overview	Author
2003	Ability of a firm to redesign their existing processes rapidly and create new processes in a timely fashion to be able to take advantage to thrive on the unpredictable and highly dynamic market conditions.	Sambamurthy *et al.*
2003	The agile paradigm focuses on the need to deliver a variety of products with uncertain demand.	Stratton and Warburton
2004	Ability to create and react to change in an unsettled business environment.	Highsmith
2004	The use of market knowledge and a virtual corporation to profit in a volatile market.	Yusuf *et al.*
2005	Ability of an organization to detect changes (which can be opportunities or threats or a combination of both) in its business environment and hence providing focused and rapid responses to its customers and stakeholders by reconfiguring its resources, processes and strategies.	Mathiyaka *et al.*
2005	Ability of a firm to dynamically modify and/or reconfigure individual business processes to accommodate required and potential needs.	Raschke & David
2005	Changes in the interlinked departments of design, production, marketing and organisation.	Storey *et al.*
2006	Relative to uncertain and changing demand, the ability to alter operating states.	Narasimhan *et al.*
2008	Associated with organisations creating pioneering products, operating in markets with high volatility, uncertainty, short life cycles and changeable supplies.	Jain *et al.*
2008	Agility is derived from the three building blocks of relevancy, accommodation, and flexibility.	Swafford *et al.*
2011	The need to respond efficiently to turbulent markets so as to meet changing customer demand volumes	Amir
2011	The supply chain outcomes from that denote organisational success in competitive, turbulent markets.	Yauch
2012	The ability to meet shifting customer demands through faster product design, manufacture and distribution with lower costs.	Hasani *et al.*

Year	Agility Definition Overview	Author
2013	The ability to work in a competitive, changing and uncertain market environment.	Pan and Nagi
2014	The creation of alliances so as to respond to customer needs with quality products more quickly and at lower costs.	Abbasi *et al.*

It was considered necessary to scale down the number of definitions into groups such that their similarities can be considered. This is illustrated in Table 2. 2.

Table 2. 2 - Groupings of Agility Definitions based upon Table 2. 1 (Author)

Groupings	Evidenced By	Number of References
Consideration of agility to be a manufacturing paradigm	Nagel and Dove (1991); Goldman and Nagel (1993); Kidd (1995); Upton (1995); Cho *et al.,* (1996); Fliedner and Vokurka (1997); Gunasekaran (1999); Narasimhan and Das (1999); Yusuf *et al.,* (1999); Christopher (2000); Mason-Jones *et al.,* (2000); Van Hoek *et al.,* (2001); Christopher and Towill (2002); Sambamurthy *et al.,* (2003); Stratton and Warburton (2003); Mathiyaka *et al.,* (2005); Storey *et al.,* (2005); Narasimhan *et al.,* (2006); Hasani *et al.,* (2012).	18
The belief that agility relates to the capacity to respond to changing and unpredictable environments	Nagel and Dove (1991); Dove (1995); Kidd(1995); Upton (1995); Cho *et al.,* (1996); Richards (1996); Fliedner &Vokurka (1997); Dove (1999); Gunasekaran (1999); McGaughey (1999); Naylor *et al.* (1999); Sharifi & Zhang (1999); Yusuf *et al.* (1999); Christopher (2000); Mason-Jones *et al.,* (2000); Meredith and Francis (2000); Rigby *et al.,* (2000); Zhang and Sharifi (2000); Menor *et al.* (2001); Sanchez and Nagi (2001); Van Hoek *et al.* (2001); Christopher & Towill (2002); Sambamurthy *et al.* (2003); Stratton and Warburton (2003); Highsmith (2004); Yusuf *et al.,* (2004); Mathiyaka *et al.* (2005); Raschke & David (2005); Narasimhan *et al.* (2006); Jain *et al.,* (2008); Amir (2011); Yauch (2011); Hasani *et al.,* (2012); Pan and Nagi (2013); Abbasi *et al.,* (2014).	35
The consideration of speed and flexibility being of importance to agile organisations	Nagel and Dove (1991); Goldman and Nagel (1993); Kidd (1995); Kumar & Motwani (1995); Upton (1995); Cho *et al.* (1996); Fliedner &Vokurka (1997); Dove (1999); Gunasekaran (1999); McGaughey (1999); Yusuf *et al.* (1999); Meredith and Francis (2000); Menor *et al.* (2001); Christopher & Towill (2002); Sambamurthy *et al.* (2003); Mathiyaka *et al.,* (2005); Swafford *et al.,* (2008); Amir (2011); Hasani *et al., (2012);* Abbasi *et al.,* (2014).	20
The consideration of a fast response and change and uncertainty to market requirements	Nagel and Dove (1991); Cho *et al.* (1996); Dove (1999); Gunasekaran (1999); Naylor *et al.* (1999); Sharifi & Zhang (1999); Yusuf *et al.* (1999); Christopher (2000); Sanchez and Nagi (2001); Van Hoek *et al.* (2001); Sambamurthy *et al.* (2003); Mathiyaka l*et al.* (2005); Narasimhan *et al.* (2006), Jain *et al.,* (2008); Amir (2011); Hasani *et al.,* (2012); Pan and Nagi (2013); Abbasi *et al.,* (2014).	18
The consideration of high quality products	Fliedner &Vokurka (1997); Gunasekaran (1999); Yusuf *et al.* (1999); Menor *et al.* (2001); Abbasi *et al.,* (2014).	5
The alteration of organisational structures so as to bring about agility	Nagel and Dove (1991); Kidd (1995); Upton (1995); Tolone (2000); Christopher & Towill (2002); Sambamurthy *et al.* (2003); Mathiyaka l*et al.* (2005); Raschke & David (2005); Storey *et al.* (2005); Narasimhan *et al.* (2006).	10

Whilst some degree of collation has been provided, with so many definitions put forward it is necessary to try to provide a more collated overview of the agility concept. Sherehiy *et al.,* (2007) considered the various definitions and concluded there to be effectively two key types of agility classifications – broad and focused. The broad perspective effectively encompasses every aspect of industry under the agility banner (as advocated by the likes of Goldman *et al.,* 1994; Yusuf *et al.,* 1999) whilst the focused argument is more organisationally or business based, suggesting that it is the organisation that has to make fast responses to changes in their operating environments (advocated by the likes of Kidd, 1994; Sanchez and Nagi, 2001).

Accepting these two classifications, it is possible to see that agility encompasses the concepts of saving money through lean production principles as highlighted by Lucio (2013). It also enables organisations to control uncertainty and change within their operating domains (Dove, 1993; Goldman *et al*., 1994; Plonka, 1997; van Hoek *et al*., 2001; Sharifi and Zhang, 2001; Zhang and Sharifi, 2007; Pilbeam *et al*., 2012) – a necessary component for future success as in order to prosper, organisations have to be aware of and be able to manage a multitude of variables (Wadwha *et al.,* 2007) and thus become agile. Authors such as Yaghoubi *et al*., (2011) have stressed the importance of agility to the extent of suggesting that non-agile organisations that are unable to respond proactively to unforeseen, unanticipated events and prospects will not survive in the future.

Despite such points, there is no clear agreement on the theoretical position of agility as a strategy or capability. Accordingly, Zhang and Sharifi (2007) stated that agility is still a concept rather than an industrial reality – a point supported by Jain *et al.,* (2008) and Vinodh and Prasanna (2011). Others such as Zhang (2011) acknowledge the extensive recognition of agility as a means for organisational progress, yet at the same time concede that the method for building agility into organisations is not fully clear.

Having considered and reviewed the agility concept, attention can now be turned to supply chains and the emergence of agility within them.

2.3. The Emergence of Agile Supply Chains

The backdrop to the business world has come to be personified by technological advances and the ability of organisations to manage international production, increased competition, and unstable and unpredictable markets housing varied and broad ranging buyer tastes, wants and needs (Gunasekaran and Ngai, 2005; Cabral *et al.,* 2012). Hendricks and Singhal (2003) argued that such obstructions and inefficiencies impact upon operating costs and performance (cost performance being organisation improvements to the costs associated with purchasing, stock holding, production and transportation (Eckstein *et al*., 2015) and operational performance being the consideration of production interrelations helping to improve quality, services and delivery (Gligor and Holcomb, 2012; Eckstein *et al*., 2015)).

Whilst integrating the need to be reactive, flexible and innovative (Lancioni, 2000; Prastacos *et al*., 2002; Bishwas, 2015) with the ever-present drive to minimise operating costs, organisations rely on any number of geographically dispersed suppliers and markets into which they can sell their products (Zhang and Gregory, 2011). Whilst such operations are financially rational, their processes increase both internal and external risk of supply chain interference (Singh *et al.,* 2011), heightened demand unpredictability (Christopher and Holweg, 2011) and change (Asmussen and Wæhrens, 2015). Issues such as the 2008 global financial crisis (Christopher and Holweg, 2011) and the 2011 Japanese earthquake (Wieland and Wallenburg, 2012, Kumar *et al.,* 2015) complicate matters further. Such challenges and increased levels of exposure to uncertainty indicate that older manufacturing methods are no longer suitable for purpose.

Incorporated within manufacturing, traditional supply chains consisting of suppliers and customers (Cook and Garver, 2002) have become more complicated, consisting of globalised information management systems interlinked by activities such as purchasing, manufacture, warehousing and distribution (Sukwadi *et al.,* 2013). Additional obfuscation is illustrated through some organisations balancing risk and suppliers against the needs of stakeholders (Börjeson *et al.,* 2015). Subsequently, supply chain relationships have been based more on a *power* relationship with one organisation dominating another, thus controlling the rules of play in their own favour (Cox, 1999). This has been exemplified in the UK by certain grocery sector organisations whose financial status has forced cost reductions on suppliers to their own advantage (Fernie and Grant, 2008) resulting in inefficient and ineffective supply chains (Hingley *et al.,* 2015).

The knock-on effect of such situations has made it increasingly difficult to manage not only the supply chain as a whole but also each element of it (Soosay *et al.,* 2008), including inventory, information, demand forecasting and resources (Lindgreen *et al.,* 2009). Chandra and Grabis (2007) argued that

organisations undergoing the changes required to maintain competitive advantage need to consider relationships (with customers, suppliers, products, processes and other factors of importance), information, financial and service flows, as well as their strategic and operational objectives and policies. They also need to ensure that knowledge sharing (Barratt, 2004; Jain *et al., 2008*) effectively takes places between all members of the supply chain – to include marketing, sales trends and predictions, and all other possible facets and permutations associated with the requirements of the end consumer of the product.

Such challenging conditions instigated the search for a method to manage issues detrimental to traditional supply chains (Abbasi *et al.,* 2014) that had effectively become misaligned (Svensson, 2000; Christopher, 2000). To help overcome such situations, Lee (2004) argued for closer consideration of supply chain relationships such that risks, expenses and rewards be divided throughout those involved, thus aligning all parties to the same goal. Along similar lines, writers such as Bernardes and Hanna (2009), Demmer *et al*., (2011) and Sharifi *et al*., (2013) argued for supply chains to be considered as a whole to meet the demands emerging from world markets.

In a bid to manage exposure and insecurities, arguments have been advocated to build agility into supply chains (Christopher and Holweg, 2011; Tang and Musa, 2011) to improve supply chain responsiveness, operational performances such as quality, services and delivery (Gligor and Holcomb, 2012), and to help manage the financial operating burden (Blome *et al*., 2013; Eckstein *et al*., 2015) so as to better align supply and demand and adaptation to markets (Christopher, 2000; Eckstein *et al*., 2015). Arguments advocating agility have gone further to suggest that financial implications should only come into effect if the supply chain as a whole benefits from them, thus ensuring the supply chain as a whole exists to win customer orders (Croom *et al.,* 2000). Through the effective implementation of an agile supply chain, competition alters and is based around supply chain rather than organisational competition (O'Marah, 2001; Wei and Zhao, 2015).

Supply chain agility positively impacts organisational performance (Gligor and Holcomb, 2012; Blome *et al*., 2013; Yusuf *et al*., 2014), and work by Ngai *et al*., (2011) exemplifies how it can help to maintain performance and competitive advantage. They assist performance improvement through the reconstruction of production facilities whilst at the same time detecting changes in market environments so as to take advantage of opportunities that might exist therein (Zang and Sharifi, 2000; Li *et al*., 2008; Li *et al*., 2009; Whitten *et al*., 2012; Blome *et al*., 2013). The argument for the development of agile supply chains has grown and whilst theoretical arguments abound for their use, practical examples exist in organisations such as Wal-Mart, H&M (Lee, 2004), Zara and Swedish fashion house Gina Tricot (Abbasi *et al.,* 2014).

The need for *agile* or *responsive* supply chains has become apparent for the benefit of all organisations within the process. Key to these organisations are suppliers and supply chain interactions that provide new knowledge, skills, products, resources, responsiveness and development standards between development, manufacture and delivery to the market (Christopher, 2000; Narasimhan and Das, 1999; Zhang and Sharifi, 2007). Cooperation between supply chain members is therefore a fundamental requirement (Wood and Brewster, 2005) to an agile supply chain's success – particularly as uncertainty levels rise (Pilbeam *et al*., 2012), providing greater levels of predictability and stability for those involved (Christopher, 1998; Lambert *et al.,* 1998). Effectively, agile supply chains extend beyond their immediate organisations to flawlessly assimilate and build relationships between associated parties to meet customer expectations – something that cannot be achieved by one organisation alone (Christopher, 2000; Christopher and Towill, 2001; Fantazy *et al.,* 2009; Hallavo, 2015). The strength of this new agile supply chain consideration has meant that organisations holding no legal bonds to one another can collaborate through the supply chain to meet mutual goals (Christopher, 2000).

Whilst it is possible to consider internal and external supply chains as almost separate entities from an operating perspective (i.e. internal management processes and external relationships with suppliers and ultimately customers) as highlighted by Rich and Hines (1997), the agile supply chain under consideration herewith is the supply chain as a whole and not one separated by linguistic boundaries. The internal-external divide is therefore only conceptual as there are effectively no borders – particularly when considered in line with the need for the supply chain to exist virtually as well as physically so as to ensure the effective flow of information between all involved organisations (Fawcett and Waller, 2014).

2.4. Supply Chain Attractiveness

When dealing with the development of agile supply chains, there is an underlying assumption that those organisations working within the supply chain are in effect *attracted* to it – thus they have a need to be part of the supply chain, whilst at the same time partner organisations require their presence. There is therefore an intentional buyer-supplier relationship between the involved parties to bring about an intended outcome (Mortensen *et al.,* 2008) and meet the buyer's needs (Handfield *et al*., 2000). Through being *externally* attractive, organisations gain financial benefits through limiting expenditure with regards relationships as those organisations involved within the supply chain are likely to be proactive and not require effort to ensure requirements are met (Cordon and Vollmann, 2002; Christiansen and Maltz, 2002; Ellegaard and Ritter, 2006). In addition to the external advantages, the

transition to an attractiveness-based supply chain provides certain internal benefits in terms of performance and loyalty for organisations by attracting a higher calibre of employee (Mortensen *et al.,* 2008).

The concept of *attractiveness* has been considered by different management disciplines and accordingly has slightly different points of emphasis from the standpoint of the speciality considering it. Over the last five decades there have effectively been three schools of thought with regards *attractiveness* as illustrated in Table 2. 3.

Table 2. 3 - Three Levels of Attractivenss Perception (Mortensen et al., 2008, pp. 802)

Attraction seen between individuals	Attraction seen within groups	Attraction seen between companies
• Thibaut and Kelly (1959) • Blau (1964) • Kelly and Thibaut (1978) • Ellegaard (2006)	• Harris *et al*., (2003) • Ellegaard *et al*., (2003) and Ellegaard (2004) • Ellegaard and Ritter (2006) • Hald and Vollmann (2007)	• Dwyer *et al*., (1987) • Fiocca (1992) • Olsen and Ellram (1997) • Cordon and Vollmann (2002)

Some consideration must therefore be paid to the constituents of the factors of attractiveness. Fiocca (1982) considered a business as a whole in order to analyse factors of attraction. Olsen and Ellram (1997) considered attractiveness from the perspective of the buyer and the strategic relationships that exist. Both parties effectively reviewed factors of attractiveness through the following dynamics:

- Financial and economic
- Performance
- Technological
- Organisational and cultural
- Strategic

In a similar way, Harris *et al*., (2003) considered factors of attraction to be:

- Economically based
- Resource based
- Socially based

Whilst accepting the similarities between these lines of thought with regards to the factors of attractiveness, and at the same time maintaining the concept of supply chain agility (and the need for all parts of the supply chain to interact openly together, providing a free-flow of information between them), Sharifi *et al.,* (2009) suggested that the basis of the framework for an effective agile supply chain should be structured around the *Four Dimensional Factors of Attractiveness* and their interactions. This framework considers factors of importance that are attractive to suppliers, from suppliers, to the supply chain initiating organisation and ultimately the customer. This is a broader perspective than the previous models as it encompasses everything that might be considered attractive within the supply chain.

Having considered the business environment, agility, agile supply chains and supply chain attractiveness, attention must be turned towards SMEs and subsequently to their alignment with supply chains, prior to considering framework models for their implementation.

2.5. Frameworks for Achieving Agile Supply Chains

Guided models or frameworks are a beneficial way to assess and test situations and subsequently aid organisational effectiveness (Johnson, 2010; Teece, 2010; Lambert & Davidson, 2012; Campbell, *et al.,* 2013, in Hoveskog *et al.,* 2015). Frameworks have changed the ways in which the business world works (Wirtz and Ehret, 2012) and according to Zott and Amit (2008), their development can help provide direction to organisations that might otherwise be operating without management philosophies, processes or systems, or the interests of stakeholders (Maglio and Spohre, 2013).

Such points lead the discussion to those frameworks that underpin this thesis. As well as agility-based models, performance measurement models also need to be considered. Whilst these models have arguably existed since the birth of scientific management, criticisms were levied at them throughout the 1980s (Kaplan and Norton, 1996) to the effect that strategic frameworks were developed in a bid to move away from financially driven assessments to more flexible variations (Dror, 2008). Various models for managing organisational performance have been proffered including the Deming Prize, the Malcolm Baldridge Award (MBNQA), the Balanced Score Card (Akbarian *et al.,* 2015) and the EFQM (Gómez *et al.,* 2015). As a means of highlighting the key objectives for the MBNQA, EFQM and Balanced Scorecard models, Table 2. 4 was developed by Dror (2008).

Table 2. 4 - Comparison of MBNQA, EFQM and Balanced Scorecard Frameworks (Dror, 2008, pp. 587)

The MBNQA excellence model	The EFQM excellence model	The Balanced Scorecard
Multiple criteria based on TQM principles: • leadership • strategic planning • customer focus (leadership triangle) • human resources • process management • business results (results triangle) • measurement, analysis, and knowledge management	Multiple criteria based on TQM principles: • leadership • people management • policy and strategy • resources processes (enablers) • people satisfaction • customer satisfaction • impact on society • business results (results)	Multiple perspectives of the strategy: • learning • internal processes • customer • financial • sequential objectives

A brief overview of some of the most popular frameworks is necessary at this point. The European Foundation for Quality Management founded the EFQM Excellence Model (Figure 2. 2) as an instrument to evaluate organisational performance (Seňová and Antošová, 2015). The model assesses organisational leadership, strategy and policies, as well as interactions with employees, associates and resources, the outcome of which is illustrated by a correlation between employee satisfaction and motivation, customers, and their interactions with the organisation in question (Ehrlich, 2006; Mehrmanesh and Taghavi, 2010).

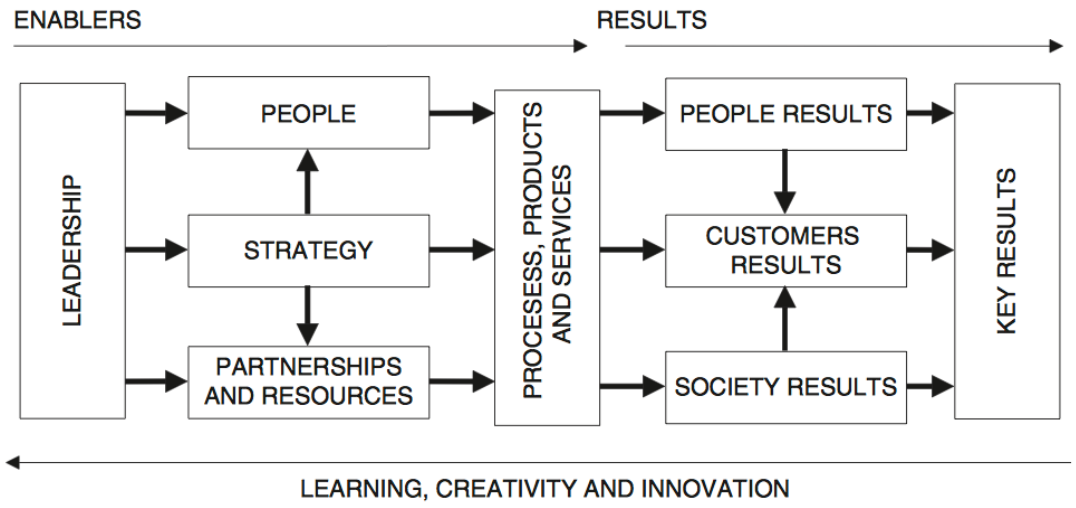


Figure 2. 2 - The EFQM Excellence Model (EFQM, 2013)

By comparison, the Balanced Score Card is a model that decodes organisational goals into performance measures based upon customers, finance, business procedures, development and expansion (Dror, 2008).

Literature highlights certain criticisms to the EFQM model. Langroudi *et al.,* (2008) argue that EFQM results are disproportionate relative to the scores awarded, while Li and Yang (2003) argue that the means of measuring responses are subjective and inexact. Further to this, (Mehrmanesh and Taghavi, 2010) argue that the EFQM model simply presents a set of results without presenting a subsequent development strategy. Dror (2008) suggests this is the case for each of these models and also suggests the Balanced Score Card model does not afford procedures to help choose performance processes.

Whilst each of these framework models proffers its own advantages and disadvantages, they do not provide the means from which to move a situation forward and models such as the MBNQA and the EFQM work predominantly around the TQM concept. Whilst quality is an important element of supply chains and agility, such models are not directly suitable for use in the development of an agile supply chain.

It is being argued from this point that a framework is required to measure the performance of an organisation wishing to develop its agile supply chain and accordingly one will be developed within this thesis. Whilst there are limited studies based around the alliance of supply chains and finished products (Caniato and Größler, 2015), Pero *et al.,* (2010) argue for their alignment and the benefits to be gained therein. So as to facilitate the successful alignment of supply chains and products, an integrated design

approach is required that takes into account not only the finished product, but also the processes through which it is made and the changes required throughout the lifespan of the product in line with customer requirements (Smets *et al.,* 2013). The supply chain must logically therefore be designed such that component and raw material supplies and their suppliers become an integral part of the agile supply chain design (Florian, 2013) so that when customer demands change, the product can be differentiated and altered in line with their needs (Constangioara, 2014, Tsinopoulos and Mena, 2015).

Ismail and Sharifi's (2006) *framework for agile supply chains* (illustrated in Figure 2. 3) helps to progress this point and assist in the design of agile supply chains. This framework is significant in this thesis as it is one of the points of initiation. This key point of reference highlights the fact that agile supply chains consist of two main features – products and supply chain networks.

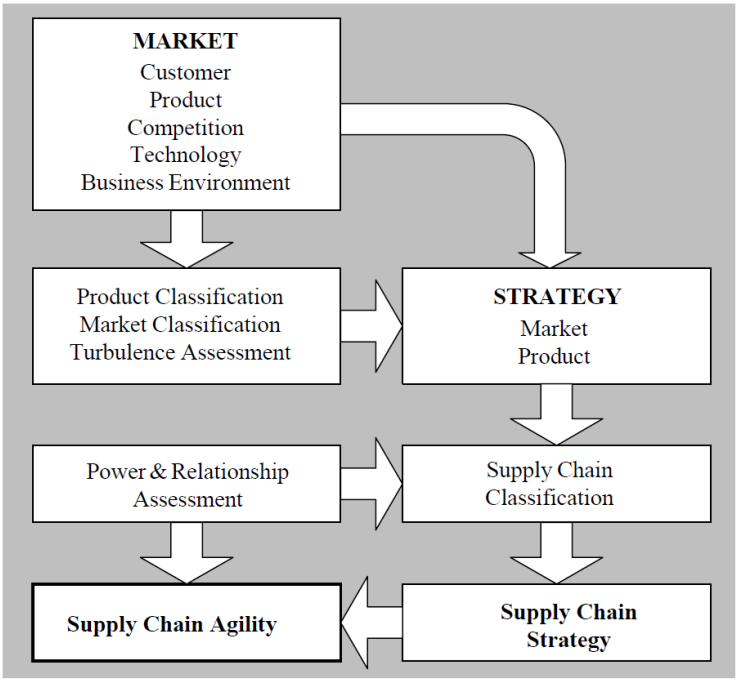


Figure 2. 3 - A framework for agile supply chains (Ismail and Sharifi, 2006, pp. 435)

Under this framework, the supply chain has to be designed, formed, developed and managed in order to run successfully (eschewing opportunistic and subsequently detrimental behaviour which could otherwise exist within supply chains (Hawkins *et al.,* 2013)). It may subsequently be dismantled or altered to meet changing market needs. At the same time the product has to be designed in line with

the needs of the market, the business environment, the manufacturing organisation and the supply chain as a whole (Ismail and Sharifi, 2006). Whilst product innovation is not new (Volkan Türker, 2012) and is something organisations must do to advance their offerings to the market, historically, product innovation and efficient and effective operations are not necessarily considered together and indeed some industrial sectors have historically considered them to be different points for consideration altogether (Cagno *et al.,* 2015).

Ismail and Sharifi's (2006) framework for agile supply chains (Figure 2. 3) set out to create the means through which agile supply chains could be developed to quickly respond to market prospects through an organised approach, advancing the idea of developing both the supply chain and the product at the same time, whilst allowing other factors to interact within the system. This *balanced approach* to supply chain agility was initiated from the models that support strategic alignment whilst also taking into account the point that organisational success is dependent upon the alignment of strategies, technology, systems and practices, as well as uncertainty as highlighted by Lufinin *et al.,* (1993) and Henderson and Venkatraman (1999).

Throughout this work, Ismail and Sharifi (2006) considered the concepts of *supply chain design* and *design for supply chain*. Supply chain design is based around the view of identifying network traits and executing them into a supply chain, thus effectively linking the supply chain strategy to the operational elements of the supply chain (Ismail *et al.,* 2006). Design for supply chain advocates a product should be designed with the end customer in mind but in accordance with the abilities of those in the supply chain, thus resulting in the ability to sell the product at any stage without the need for new development in order to meet requirements. At the same time, any developments that do occur within the supply chain can be integrated into the new product, thus enhancing its saleable properties.

Supply chain design aims to develop a stage from which the supply chain can be managed (Sharifi *et al.,* 2009). A common method in the supply chain design is to highlight a product's features and to subsequently find suppliers that can provide the necessary components for these features. The supply chain itself consists of interlinking these suppliers with arguably divergent interests. Over time these chains break down and subsequently need to be restructured. The supply chain design is therefore of both strategic and operational interest and must be set up with clear objectives. There are however difficulties associated with supply chain design, most notably configuration and the management of the supply chain (Chopra and Meindl, 2004).

Design for the supply chain considers the original product design and then allows for a re-design based upon the resource and capability limitations of those in the supply chain - accordingly, product features that are not required are eliminated in order to develop a practicable product (Sharifi *et al.,* 2013).

Arguably, this allows for future capabilities within the supply chain to be incorporated into future products and thus enhances the agility of the process as a whole.

It is important to note that the agility concept is incumbent upon the supply chain as a whole and the businesses involved therein – particularly with regards their psyche and make up (Christopher and Towill, 2001), and accordingly these concepts impact upon it. With these points in mind, Ismail and Sharifi (2006) integrated the *supply chain design* and *design for the supply chain* concepts into a single model to balance their approach to developing an agile supply chain (illustrated in Figure 2. 4).

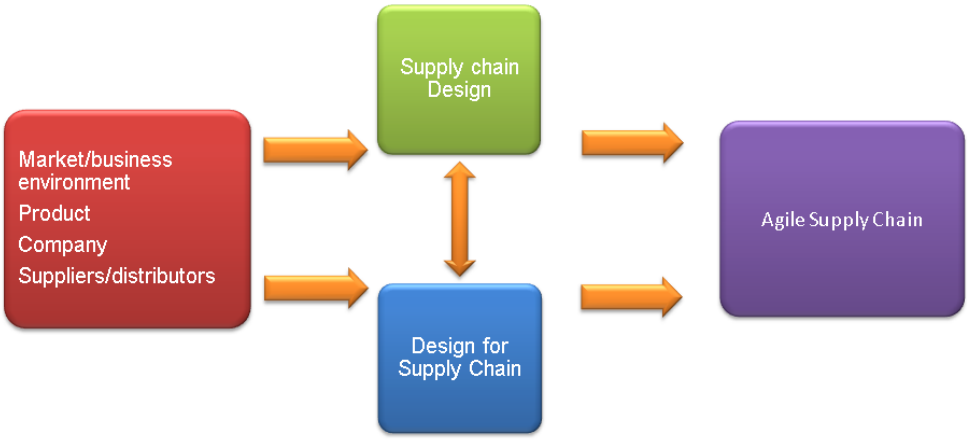


Figure 2. 4 - Agility in supply chains through design of supply chain and design for the supply chain (Ismail and Sharifi, 2006, pp. 440)

Sharifi *et al.,* (2009) advanced this work, advocating that an agile supply chain comes about through closely integrating the product design with the supply chain design whilst at the same time linking them into the strategic direction of growth for the organisation. This point is supported by the framework for agile, future-proof supply chains (Sharifi *et al.,* 2009) that argues that the *supply chain operations* and the *product* are the two key elements of consideration in terms of effectively delivering the required output.

This model was further developed by Ismail *et al.,* (2011) into the strategic agility framework stages model (Figure 2. 5), which illustrates the stages an organisation would go through to become agile.

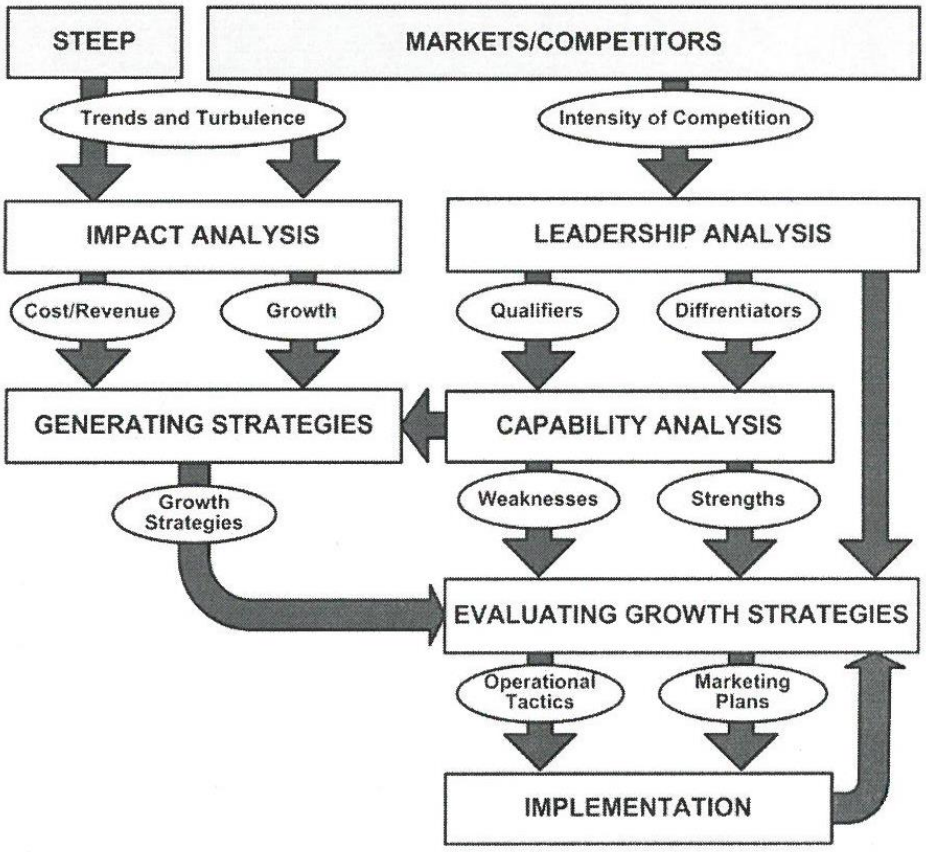


Figure 2. 5 - Strategic Agility Framework Stages (Ismail et al., 2011, pp. 5475)

Maintaining the notion of design for supply chain, Sharifi *et al*., (2006) and subsequently Sharifi *et al.,* (2013) developed the *extended Ansoff matrix*. In order to consider this fully, a brief overview of the Ansoff matrix is required. The Ansoff matrix (Ansoff, 1965) is an instrument to assist organisations in determining the products to be sold and the strategy required in order to achieve market growth for the said products. The matrix (Figure 2. 6) considers the marketing of new or existing products for the organisation in question and whether or not they are to be sold into new or existing markets. Having established where a product fits within the matrix, a strategy can be devised to enable the organisation to move matters forward and grow (Richardson and Evans, 2007).

	Existing Products	New Products
Existing Markets	Market Penetration	Product Development
New Markets	Market Development	Diversification

Figure 2. 6 – Ansoff Matrix (Ansoff, 1965 in Richardson and Evans, 2007, pp. i)

Having established the matrix and a strategy from which the organisation can base its actions, the Ansoff model provides an effective principle for determining the direction to further grow the business both in terms of the product, through innovation, and market expansion. This provides insight into the likely supply chain that will be required in order to manufacture products.

Taking the Ansoff model further, Sharifi *et al.,* (2006), and Sharifi *et al.,* (2013) developed the extended Ansoff matrix (Figure 2. 7).

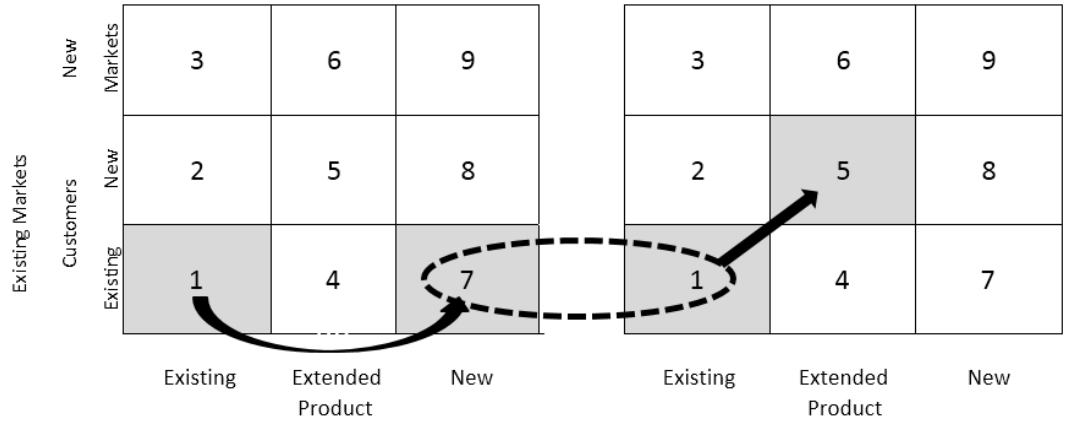


Figure 2. 7 - Extended Ansoff Matrix (Sharifi et al., 2013, pp. 398)

Under the *extended* Ansoff matrix, an organisation may ordinarily make more sales by progressing through cells 1, 2 and 3. It may be possible to do this by making use of cost saving exercises to bring about efficiency gains and by aligning the supply chain with the organisational strategy. Should the

organisation wish to extend its market offering, it would need to extend its product range in order to move into cells 4, 5 and 6. It might require the supply chain to be remodelled to achieve this (Ismail and Sharifi, 2006).

Whilst it may increase the risk facing the organisation, by moving the emphasis from cell 1 to cells 7, 8 and 9, the organisation is forced to consider the needs of new products and services. At the same time, there is a supply chain benefit in as much as this forces the organisation to consider the true product requirements and the needs from the supply chain as a whole (Ismail and Sharifi, 2006).

Having considered supply chain and product design, both were aligned via integrating supply chain design and design for supply chain by Sharifi *et al.,* (2006) in the *agile supply chain development framework* (Figure 2. 8).

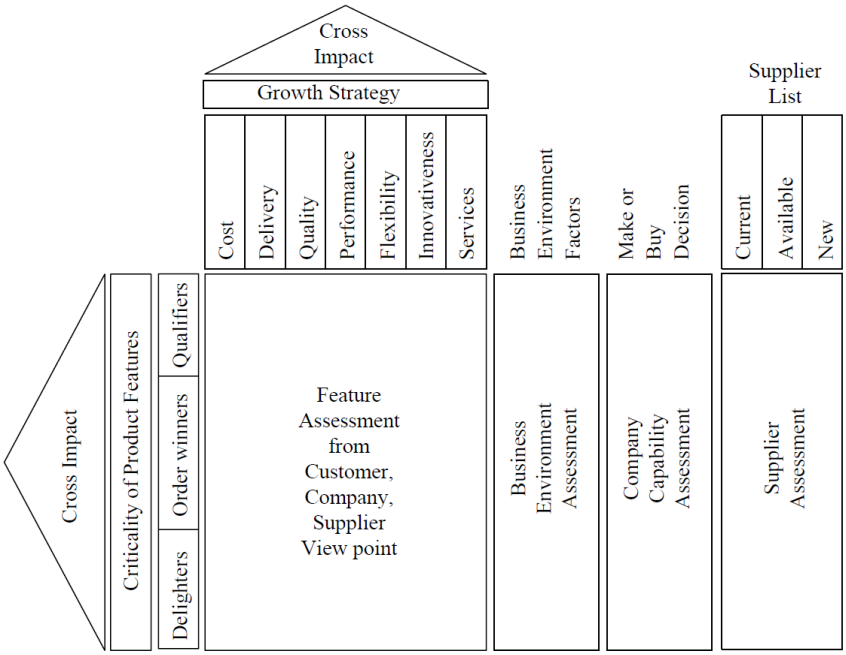


Figure 2. 8 - Agile supply chain development framework (Sharifi et al., 2006, pp. 1094)

Having established the theoretical baselines from which this thesis is based, it is necessary to establish the product requirements under consideration as this will impact upon the model under development.

2.6. Frameworks for Establishing Product Requirements

Historically and by the virtue of human nature, we are programmed to expect more – a point verified by the Food Market Institute in Brat *et al.,* (2009) whereby it was established that the number of products for sale in the average supermarket increased by 50% between 1996 and 2008. The proliferation of supermarkets, online purchasing and other stores in the non-food sector has increased over the last few decades, suggesting further that vast consumer choice is the way to build a successful business – organisations such as Tesco and WalMart verify this line of argument (Barrison, 2011).

Conversely, Syam and Bhatnager (2015) highlight that the fastest growing supermarket in the UK is Aldi whose growth has been established through low prices and a restricted selection of products. Discussions based around product variety are not therefore straightforward, and the provision of limited product choices are not restricted to businesses such as Aldi – other companies are following a similar strategic path (*Ibid)*.

Working with the logic that limiting consumer choices is paramount and that within the choices presented to customers, products must contain features that are positively required, a challenge is presented to organisations – to detect the features of key importance. In recent years, various methods of data mining have been proposed that determine consumer-buying trends (Moon *et al.,* 2010), thus providing large organisations with key decision-making information from which to determine product features.

Other efforts to ascertain product attributes consumers require have been considered including various psychological-marketing based concepts. Hu and Liu (2004) presented a sentiment analysis model to mine data and summarise product reviews. Their work was explored further by Popescu and Etzioni (2005) by linking it into web-based searches, and Ding *et al*., (2008) who considered it from a more all-inclusive perspective. Whilst there are benefits for firms using sentiment analysis, the analytical algorithms required must make use of external information and controls and have been deemed to be limited in their use (Qiu *et al*., 2011; Quan and Ren, 2014).

Such tools are expensive though and surely out of the reach of most SMEs, which would suggest that for such organisations to determine their key product features, other methods must be employed.

Statistical analytical tools have been advocated by authors such as Billeter *et al.,* (2011) and Lakshmanan and Krishnan (2011) to assist in this area. Consideration of the tools for use for this thesis will be considered in the Theoretical Framework chapter.

2.7. Frameworks for Establishing Supply Chain Partners

Component and material sourcing is important in agile supply chain development (Aghai *et al.,* 2014). Accordingly, supply chain partnerships can be used to gain competitive advantage over rival organisations (Brito *et al.,* 2014) and their development is seen as an important aspect of the agile supply chain development task (Chen and Paulraj, 2004; Hus and Hu, 2009), improving performance, effectiveness, innovation and long-term survival (Nepal *et al.,* 2011). SMEs further benefit from supply chain partnerships through gaining access to technology and expertise from outside sources (Lambert and Schwieterman, 2012).

Various definitions have been put forward for partnerships – an overview table of which was compiled by Rezaei *et al.,* (2015) in Table 2. 5.

Table 2. 5 - Definitions of Partnerships (Rezaei et al., 2015, pp.1529)

Partnership definition	References
A type of channel relationship where the intent of the relationship is to yield differentiated and intermediate or long-term benefit to the parties involved in the relationship.	Ellram and Cooper (1990)
A relationship formed between two independent entities in supply channels to achieve specific objectives and benefits.	Maloni and Benton (1997)
An inter-organisational entity developed between two independent organisations in a vertical relationship within a supply chain.	Mentzer, Min, and Zacharia (2000)
A relationship formed between two independent members in supply channels through increased levels of information sharing to achieve specific objectives and benefits in terms of reductions in total costs and inventories	Yu, Yan, and Cheng (2001)
A tailored business relationship featuring mutual trust, openness, and shared risk and reward that yields strategic competitive advantage.	Hagelaar and Van Der Vorst (2001)
A tailored business relationship based on mutual trust, openness, shared risk and shared rewards that results in business performance greater than would be achieved by the two firms working together in the absence of partnership.	Lambert, Emmelhainz, and Gardner (1996) and Lambert (2008)

A number of key factors affect the ways in which supply chain partnerships operate and work together. Anderson and Narus (1990) argued that as they are co-dependent, management and forecasting between supply chain partners results in refined systems and increased profits, consequentially drawing supply chain partners more closely together in their actions. This is similar to Johnson (1999) who argued that due to inter-firm supply chain reliance, organisations cannot develop strategies without supply chain partner involvement – as such the reliance itself delivers the appropriate operating grounds upon which partnerships work.

Information sharing is also a key interest, with openness and transparency therein being seen as a means to improve supply chain effectiveness (Childerhouse and Towill, 2003). Kwon and Suh (2004) further developed this line and considered information sharing to lessen partnership disagreements and develop commitment within the supply chain. Li *et al.,* (2006) continued work in this area, arguing that clear and open communications are required to ensure a supply chain operates in unity to meet customer requirements. Li *et al.,* (2006) also argued that relationship stability, diversity, indigenous factors and inter-organisational reliance also contribute to partnership performance. Such points are supported by Caloffi *et al.,* (2015) who suggest that as well as relationship stability, relationships themselves, similarity of interests and the links between organisations are important elements of partnerships.

A significant component of supply chain partnerships is trust (Johnston *et al.,* 2004; Cai *et al.,* 2010; Bachmann and Inkpen, 2011; Miquel-Romero, 2014). Trust is considered to be the inclination of a party to believe in the ability of another such that they both benefit from the relationship (Cai *et al.,* 2013). Surprisingly only a limited amount of research has been conducted in this arena (Dyer and Chu, 2011; Sengun and Wasti, 2011) yet trust can be considered from several perspectives. From an economic point of view, trust can deliver savings due to the elimination of control and coordination policies (Sako, 1992; Bromiley and Cummings, 1995, Vieira *et al.,* 2013). It is also important for information sharing purposes as poor information results in performance issues (Giard and Sali, 2013) and accordingly trust and social factors enable and enhance knowledge sharing and help to share risk (Sako, 1992; Ireland and Webb, 2007; Vieira *et al.,* 2013). Sako (1992) and Yeung *et al*., (2009) also considered competence, goodwill and contractual elements of trust, within which competence is the belief in a partner's ability to meet obligations, goodwill is the belief in a partner to exceed those expectations, and from a more legalistic standpoint, contractual trust is the belief in a partner to honour agreements. Contractual trust was advocated by Stern *et al.,* (1998) who suggested contracts can establish the formal grounds upon which partnerships are based, thus establishing stability and confidence between partners – a point supported by Handfield and Bechtel (2002) who also argued that financial outlays within a supply chain are likely to deliver high levels of output and partnership commitment.

A further factor associated with preserving long-term supply chain partnerships is loyalty (Shaalan *et al*., 2013), derived from high quality outputs and the resultant satisfaction they yield (Zeithaml, 2000). This is something that Li (2011) argues is often overlooked by supply chain managers yet its importance is such that provided loyalty remains, partners tend to eschew the task of finding new associates, thus raising loyalty factors even further (Fullerton, 2003). In turn, such loyalty enables changes to be more readily adopted throughout the supply chain as a whole (Zeithaml *et al.,* 1996) – an important point for SMEs with limited funds as this reduces cost expenditure that can be allocated elsewhere.

Supply chain partnerships can benefit from other factors such as loyalty recognition programmes yet they tend to be associated with customer allegiance (Cao *et al.,* 2015) rather than partnerships. Possibly of greater interest are transparency factors (Doorey, 2011) which are vital to on-going organisational sustainability (Mol, 2015) and which in turn will increase loyalty. Transparency is the clear reporting of organisational activities, thus enabling organisations to transfer influence from themselves to interested parties within the supply chain (Martinez and Crowther, 2008). Egels-Zanden *et al.,* (2015) drew together various supply chain transparency terms, concluding that supply chain transparency consists of supplier details to enable tracking, supplier sustainability information and the business practices of those involved in the supply chain. Transparency is of interest to stakeholders in terms of sustainability and corporate social responsibility issues, thus assisting in the supply chain partner selection process (O'Rourke, 2003) and customer retention (Bhaduri and Ha-Brookshire, 2011), yet despite such knowledge, supply chain transparency has not been universally forthcoming for commercially sensitive reasons (Doorey, 2011).

Whilst supply chain partner selection is important for all organisations, the task facing SMEs is more challenging due to their limited resources and dependence upon suitable suppliers for the future. Bringing the factors considered together assists organisations in supply chain partner selection, which is no easy task (Hong *et al.,* 2014). A challenge facing supplier selection was highlighted by Chai *et al.,* (2013) who identified that no systematic literature review existed of supply chain supplier selection. Subsequently, Chai *et al.,* (2013) conducted such a review, considering publications between 2008 and 2012. The key areas under consideration were highlighted as being:

- Certain decision approaches
- Basic fuzzy hybrid approaches
- Triangular fuzzy hybrid approaches
- Trapezoidal Fuzzy Hybrid Approaches

- Intuitionistic Fuzzy Hybrid Approaches
- Interval valued Intuitionistic fuzzy hybrid approaches
- Non-Fuzzy Uncertain Hybrid Approaches

From the 123 articles reviewed by Chai *et al.,* (2013) and the key characteristics considered, the most predominant combined area of research in this field makes use of fuzzy mathematical variations. Whilst authors such as Ölçer and Akyol (2014) and Aghai *et al.,* (2014) have made use of fuzzy mathematics to consider supplier and contractor selection options to good effect, fuzzy mathematic logic has not been utilised in the research and subsequent models considered in this thesis as from a practical perspective it would be unlikely that an SME would be able to make practical use of a complex tool built around such logic. The intention is to ultimately provide an SME with a more simplistic practical tool from which relevant output data can quickly be put into action.

2.8. Frameworks for Establishing Roadmaps

The final stage of the agility development process is for an organisation to become *proactive* to ensure agility planning comes to fruition (Ismail *et al,* 2011). Sharifi and Zhang (1999) suggested that agility implementation had been considered from an idealistic standpoint only and subsequently, Zhang and Sharifi (2000) argued that realistic tools for agility implementation were unclear. Despite Vázquez-Bustelo *et al.*, (2007) suggesting that the agile concept has been encouraged without the tools to ensure it can be implemented, the problem still remains (Zhang, 2011).

Various methodologies do exist though to assist in the development of supply chains including the Global Supply Chain Forum framework (Lambert *et al.,* 2005), Value Reference Model (Ntabe *et al.,* 2015), Process Classification Framework (APQC, 2016), Sustainable Balanced Scorecard (Kima and Rheeb, 2013) and Life Cycle Analysis (Kucukvar *et al.,* 2014). However, the Supply Chain Council's *Supply Chain Operations Reference* SCOR model is considered to be the international standard against which all other models are compared (Zangoueinezhad *et al.,* 2011).

The Supply Chain Council's *Supply Chain Operations Reference* SCOR model is a generic standard applied to supply chain management that facilitates communication and practices within the supply chain as a whole. It makes use of four key levels. Level 1 considers the processes of planning, sourcing, making, delivering, returning and enabling with the view of improving operations for the supply chain as a whole

(Lu *et al.,* 2013). Level 2 considers the key processes that make up supply chains from which organisations can decipher their best operating mode. Level 3 specifies the information needed for organisations to design enhancements to their supply chain relative to best practice techniques. Level 4 aims to facilitate implementation of the improved supply chain design (Li *et al.,* 2011).

Despite its international standing, the SCOR model is not without criticism. Lambert *et al.,* (2005) argued that the SCOR model was predominantly concerned with certain key functions around which an organisational supply chain operates. Cai *et al.,* (2009) and Clivillé and Berrah (2012) argued that as the SCOR model operates as an all-encompassing model, it does not have the ability to adapt to real-world situations involving only key performance indicators operating relative to organisational circumstances. Estampe *et al.,* (2013) argued that the SCOR model ignores levels of supplier maturity when considering supply chain partners. Whilst a few authors such as Alomar and Zbigniew (2014) have considered the SCOR model in line with SMEs, this is exceptional and by default the model is generally considered to be the territory of larger organisations.

With these points in mind, and having considered agility, agile supply chains, product features and supplier selection, this thesis will present a model to decipher the present operating state of an organisation wishing to pursue the development of its agile supply chain. Whilst not the fundamental aim of the research, a guide for the means of implementation is going to be proposed via roadmaps.

The idea in principle is that through the use of roadmaps, an SME can transform and become proactive in its approach to agility and will therefore, theoretically at least, be moving towards achieving its goals. At the same time the issue advocated by Sharifi and Zhang (1999), Vázquez-Bustelo *et al.*, (2007) and Zhang (2011) are going to be addressed.

A starting point for the roadmap for this thesis is the Ismail *et al.,* (2006) *agility road map process* (illustrated in Figure 2. 9) to help in devising the plans and tools needed for agility implementation, as well as to monitor the plans once implemented. This roadmap helps to identify and measure the interrelationship between outputs (strategic priorities) and organisational capabilities, taking into account key measurement identifiers of delivery, cost, quality, performance, flexibility, innovativeness and service.

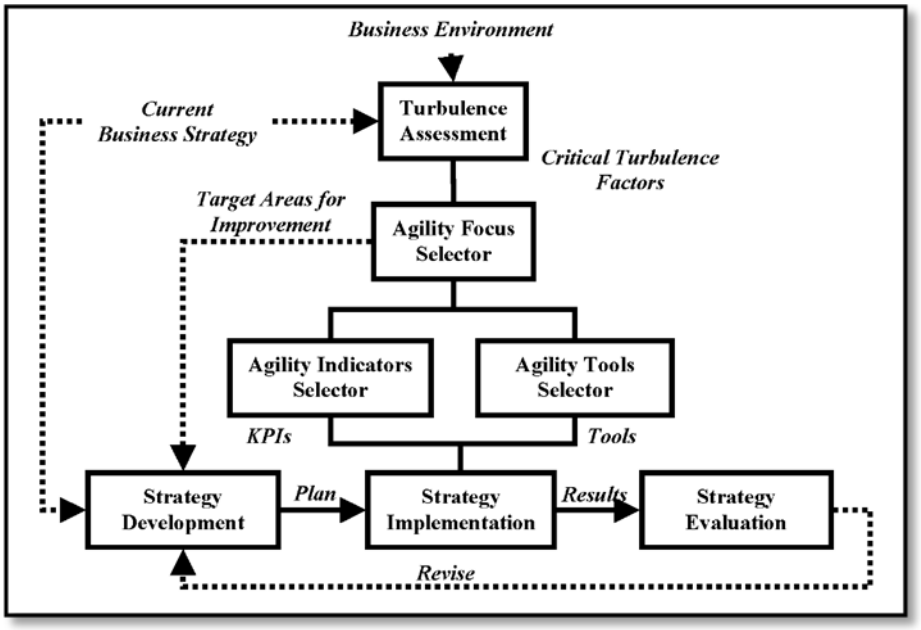


Figure 2. 9 - The Agility Road Map Process (Ismail et al., 2006, pp.15)

The model takes into account the environmental turbulence levels and the influences this has on the organisation, whilst at the same time considering the organisation in three stages – operational robustness, their ability to respond to customers and their capacity to grow. The basic model incorporates the following:

- Identify the business strategy
- Understand the business environment and the degree of turbulence within it
- Identify the level of control the organisation has within the environment
- Identify the level of impact the organisation has within its environment (effectively the opportunities and threats facing the organisation)
- Link the turbulence factors into the strategies available to overcome the turbulence

The model raises a good degree of interest in that much of the literature considered thus far has identified that there is a need for the development of agile supply chains. The *agility road map* (ARM) model provides a pathway from which an agile supply chain could be developed to take an organisation forward with its supply chain strategy.

Whilst there is no standard definition afforded to roadmaps (Kostoff and Schaller, 2001), they are used in industry for strategic planning to assimilate businesses and technology, providing a framework for forthcoming improvements, and in ensuring investment is carried out in line with business drivers and market needs (Amer and Daim, 2010; Martin and Daim, 2012). They furthermore provide the means of communication and information sharing within organisations (Phaal, 2004) and provide information needed to make improved decisions (Beeton, 2007).

Given the fact that a roadmap methodology is being developed herein for agile supply chains within SMEs, it is logical to consider various methodologies available at the present time. As the processes under consideration within the roadmap need to consider the sequence of activities an SME would follow in order to become agile, these are best represented via a schematic methodology. Numerous methodologies have been put forward in terms of roadmap development. Whilst some might appear to be more appropriate in achieving specific goals, no method is acknowledged as being the best (de Laat, 2004). Despite this, roadmap methodologies house the generic means of presenting a pathway or route to be travelled to reach an end destination and the roadmap process affords the means to recognise, appraise and choose substitutes relative to a chosen goal (Kostoff and Schaller, 2001). Roadmaps usually comprise nodes (or activities) and links illustrating the connections between the nodes (Kostoff and Schaller, 2001), the activities being devised via interrogation of experts and future roadmap users (Lee *et al*., 2012).

According to Akash *et al.,* 2010, the schematic, structured model options available include SSADM (Structured Systems Analysis and Design Methodology), SADT (Structured Analysis and Design Technique), GRAI (Groupe de Recherche en Automisation Itegrere) and IDEF (Integration Definition for Function).

SADT was developed into IDEF standards (Presley and Liles, 2015), which present an ordered, structure of the events taking place within the organisation under consideration. Each event or activity utilises inputs, outputs, implementation tools and the means of control in order to communicate the actions taking place around it. It is felt that IDEF is the most suitable option to consider for roadmap development in this thesis as it illustrates information flows, organisational controls and practical workflows (Softech Inc., 1981) and has been tested for such within SMEs (Presley and Liles, 2015). IDEF0 benefits are illustrated in the long-term adoption of the methodology by the United States Air Force as a methodology for architecture. The IDEF0 diagrams developed herewith make use of data from the internal environment the organisations in question operate within as well as the external environment (Ismail *et al.,* 2010). An overview of the IDEF workings is presented in the theoretical framework chapter.

2.9. SMEs

One of the key elements of this thesis centres upon SMEs and accordingly, consideration must be given to such organisations, their meaning, nature and values. Whilst international variations of SME definitions exist (including specifics such as the allowable annual turnover), there is no definitive global definition followed (Kumar and Sosnoski, 2011; Robu, 2013). Furthermore, there is evidence that definitions change over time so as to incorporate more organisations into the SME category such that they may benefit from certain forms of government assistance (Kumar and Sosnoski, 2011), thus making them more robust to market fluctuations and helping to stabilise elements of societies. However, the fundamental SME classification premise remains largely the same throughout the world. For the sake of this research that involves SMEs, the definition held by the European Commission (2003) is being taken as a basis from which to move forward. According to the European Commission (2003), an SME (Small and Medium Sized Enterprise) is defined as:

> The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million euro.
>
> (The European Commission, 2003, pp.39)

Robbins (2000) and Lawton-Smith (2007) highlight the significant role SMEs play in economies around the world with their importance increasing due to pecuniary changes over the last few years. Ismail *et al.,* (2011) further acknowledge the historical importance of SMEs in terms of wealth and job creation and Kamalian *et al.,* (2015) suggest the increasing numbers of SMEs is a direct response to economic and technological changes, such that SME organisations now provide great opportunities for sustainable development in many countries (Eniola and Ektebang, 2014).

Whilst immediate thoughts relating to SMEs might be considered in relation to western countries, they play a significant role in developing nations too (Hunjra, 2011; Kraja and Osmani, 2013). If SMEs are considered important in an expanding economy, their international importance and impact upon all economies cannot be underestimated. They are recognised as a major contributor to employment within Western economies (Ismail *et al.,* 2011), and make up approximately 90% of businesses in European and developed Western economies (European Commission, 2003; Bennett, 2008).

From the standpoint of the UK, there is considerable importance placed upon SMEs as according to The Federation of Small Businesses (2016):

- Small businesses accounted for 99.3% of all private sector businesses at the start of 2015 and 99.9% were small or medium-sized (SMEs).
- Total employment in SMEs was 15.6 million; 60% of all private sector employment in the UK.
- The combined annual turnover of SMEs was £1.8 trillion, 47% of all private sector turnover in the UK.

Historically, SMEs have operated on relatively small scales within certain geographic boundaries (Salavou *et al*., 2004). The rapid advancement of internet-based businesses has resulted in SMEs facing increased competition from around the world (Gunasekaran *et al.,* 2011, Demmer *et al.,* 2011) – a factor that has to be considered by the multi-partner supply chain networks many SMEs operate within to diminish liabilities (Agostini *et al.,* 2015). Yet, irrespective of a world facing increasing customer demands (Kotler and Caslione, 2009) and organisations with new capabilities (Rice and Caniato, 2003), SMEs are unlikely to expand and develop in a linear fashion (Gunasekaran *et al.,* 2000).

As well as this increase in international competition, SMEs are having to interact with supply chains in new ways – an issue that affects costs (Hendricks and Singhal, 2005) and ultimately makes them potentially more vulnerable to market fluctuations (Thun *et al*., 2011; Vargo and Seville, 2011) than their larger organisational counterparts (Ismail *et al.,* 2006; Bhamra and Dani, 2011). The work by Pollard and Hotho (2006) suggests that many SMEs effectively exist within a state of denial with regards these uncertainties, citing a lack of resources or the likelihood of impact as reasons for not acting. Yet despite the outline knowledge of this attitude towards such situations, there is little evidence of research that considers the challenges organisations face in these types of areas, and the research that has been conducted is largely inappropriate to SMEs (Herbane, 2010), which tend to share some common characteristics such as resource scarcity (Sullivan-Taylor and Branicki, 2011).

The constraints SMEs operate within have been historically well documented with authors such as Vossen (1998), Kirchhoff (1994), Herbane (2010), Sullivan-Taylor and Branicki (2011) and Löfving *et al.,* (2013) highlighting the financial restrictions faced on a day-to-day operating basis. Acs *et al.,* (1990) advocated that SMEs are financially vulnerable to both market shifts and volatile events. Bhamra and Dani (2011) argue that SMEs are vulnerable to not only these financial situations but also to legislature, relationships within the supply chain, market volatility and national economic failures. Vargo and Seville (2011) support these points but also add human resources as a potential threat to the list of

vulnerabilities SMEs face.

It is interesting therefore to consider Gunasekaran and Ngai's (2005) case study on Dell computers, which considered the strong supplier relationships in existence resulting in a fully integrated supply chain. Arguably, such a model could be replicated in many supply chains – including those of SMEs. However, whilst such a model may be possible for a financially stable international organisation to operate, it is perhaps less feasible for an SME to achieve the same. This point is of particular note for SMEs from less developed, third world nations who wish to compete in a larger market place but need the financial backing in order to achieve this.

Extending this discussion, extreme events and natural worldwide disasters (causing US$99.2 billion of economic damage (Guha-Sapir *et al.,* 2014)) and world issues such as the 2008 financial crisis (Christopher and Holweg, 2011) naturally increase the levels of strategic uncertainty and disruptions that organisations face (Sullivan-Taylor and Wilson, 2009; Burnard and Bhamra, 2011). Authors such as Rudrajeet *et al.,* (2014) argue that during economic downturns, SMEs are particularly subject to financial hazards and bankruptcy. Evidence suggests that SMEs are more liable to suffer the impacts of the after effects of such events than their larger competitors (Wagner and Neshat, 2010; Thun *et al.,* 2011; Vargo and Seville, 2011). Ismail *et al*., (2011) argue that SMEs have to deal with greater stresses than larger organisations that benefit from greater resources and subsequent resilience to events (Herbane, 2010).

With this argument in mind, the challenge faced by SMEs is substantial; developing and manufacturing products and services to rival world-class organisations is a time consuming and costly exercise. Furthermore, given the relationships that endure within pre-existing supply chains it is difficult to break into the supply chain loop in order to develop an organisation further. Once within the loop, the organisation faces political challenges from other business interactions (Chen and Paulraj, 2004). Organisations are also often hampered by the dominance of certain key suppliers within the chain who recognise an SME for its position (Hakansson and Snehota, 1995) as often being less important than others they supply to, simply due to their throughput and by implication, financial significance. This logically ought to suggest that SMEs should approach new suppliers (provided they exist) that are positively interested in working together (Schiele, 2006).

Despite the challenges faced, SMEs do house certain advantages over their larger scale rivals such as having less bureaucracy and the ability to adapt quickly to changing circumstances and situations (Sullivan-Taylor and Branicki, 2011; Gunasekaran, 2011). According to Sull (2009) and Ismail *et al*., (2011), linking these advantages to agile supply chains is a logical means through which to help SMEs compete in the future. In accepting that there are advantages to linking the agile supply chain concept to SMEs, there remains the issue of bringing the concept to practical reality in uncomplicated and easily

used formats (Hemilä and Vilko, 2015). Failure to keep such a tool simple is likely to result in SMEs losing their agility (Sharifi *et al.,* 2013).

At this stage, the meaning and general nature of supply chains and SMEs has been considered, as well as their role and importance in international economies. Rational arguments have also been considered to suggest that a means of SMEs competing more effectively could come about through the development of agile supply chains (Sukwadi *et al.,* 2013). Whilst such arguments are well grounded, a challenge arises in the practical implementation of agile supply chains within SMEs in as much as the said organisations are subject to limited financial as well as other operating conditions. Such constraints may preclude or eliminate the chances of agile supply chain implementation. The lack of resources and nature of SMEs quite simply presents a game-changing situation for any agility-based arguments that could be put forward.

2.10. Supply Chains and SMEs

Market competition has changed from operating at a national or international perspective to operating on a global level (Ahmedova, 2015). Again, the emphasis on being competitive is paramount, and the need to simply produce goods on a mass scale with reduced costs is logically only part of the overall argument. The need is to be able to manoeuvre within the market and supply in-demand goods at short notice (at the right cost) to win customers. Such an order requires an integrated and agile supply chain – something that the larger MNCs have but SMEs (on the whole) have not yet developed (Quayle, 2003).

Such positions can in part be associated with the supply chain - it is clear that well-defined and developed supply chains deliver stronger profits and economic influence to those involved. It is however of note that many organisations do not believe supply chain resilience to be an integral element of their risk strategy (Kumar and Sosnoski, 2011) and is therefore something that can be overlooked or ignored by SMEs.

The operating states and structures of SMEs have been previously acknowledged, along with the challenges they face. Their ability to influence supply chains have been historically limited, yet despite the small organisational stature of an SME and the servant-like role it could be assumed they must adopt, they play a prominent role in international supply chains. Far from simply being a small cog in a large machine, the importance of SMEs can be simply illustrated by the fact that any organisation wishing to manufacture on a large scale is almost certainly bound to be dependent upon suppliers -

many of whom will be SMEs (Gunasekaran *et al.,* 2011). When an SME makes a decision, its impact will be felt by others in the supply chain itself – SMEs therefore ought to consider the impact of decisions upon other parties (Archer *et al.,* 2008). To maintain their position and to remain justifiable, SMEs therefore need to consider their strategies and operating practices (Gunasekaran *et al.,* 2011).

There is therefore a need for SMEs to create and develop supply chains and ensure they are fully integrated with complete cooperation taking place between all interested parties. Yet despite the need for SMEs to do so, Stonehouse and Pemberton (2002) argue that SMEs tend not to use strategic tools and theories. Furthermore, Ghobadian and O'Regan (2006) argue that most research considering strategic performance has been based on organisations other than SMEs. This is arguably due to the simplistic management methods used by SMEs resulting in difficulties linking organisational strategy to performance (Parnell *et al.,* 2015). Accordingly, as highlighted by Ismail *et al.* (2011), SMEs may be more suited to operating in a position of strategic readiness, ensuring the organisation thinks and plans strategically as functioning in such a way can lead the SME to new international markets (Toulova *et al.,* 2015). Thus through awareness of strengths and weaknesses, an organisation can consider its prospective strategies (Ismail *et al.,* 2011).

It would therefore be logical for an SME to pursue the concept of developing an agile supply chain to at least maintain its position in the market place, if not to expand and challenge its larger rivals. Provided an SME wishes to pursue agility, and acknowledging that the chances of long term success are likely to be greater if the supply chain is closely integrated, there are points to consider regarding the motives behind supply chain partnering and partner selection. Developing successful partnerships is an expensive and time-intensive process, requiring partners to commit, adjust to each other's requirements and develop and share resources and learning (Wang and Kess, 2006). A strong rationale for joining a strategic partnership in a supply chain is the need for the partner companies to tactically develop together (Eisenhardt and Schoonhoven, 1996; Hoffmann and Scholsser, 2001). This is further supported by Koza and Lewin's (2000) research whose findings made the argument that the key rationale for entering into a partnership is to add to and provide support for the strategies of the parent organisation in the chain. Yet at the present time, no straightforward model exists to assist SMEs in implementing their resource and capability limitations into an agile supply chain (Ismail *et al*., 2011)

There is therefore a need for organisations to not only collaborate and work closely together, but for them to recognise the benefits of working together. Such a point has been made by authors such as Contractor (1986), who highlighted seven key benefits for organisations working together:

1. Reduction of risk
2. Economies of scale and/or rationalisation
3. Use of complementary technologies and patents
4. Working together to block competition
5. Overcoming government-controlled interests or barriers to trade
6. International expansion
7. Vertical integration

Whilst these points cannot be disregarded, it can be argued that the element of risk might have a combining benefit to those partners within the supply chain, and might even be beneficial to all involved. Through spreading risk, the supply-chain partner benefits (in the case of this thesis the SME), but by acknowledging the risk throughout the supply chain, the partnership is bound more tightly together such that it is less likely for a partner to exit the chain once committed to it.

When considering SMEs from a macro standpoint, it is clear that there are benefits to be derived from the development of effective (and agile) supply chains. At the same time though there are potential drawbacks – the decision-impact highlighted by Archer *et al.,* (2008) is significant. However, bearing in mind the macro perspective and the increasingly competitive nature of world markets, should an SME wish to compete for custom, there is strong rationale for the consideration of the development and implementation of an agile supply chain in order to assist it.

2.11. Research Gap

At this stage in the literature review, key areas of interest relating to the research in hand have been considered including the business and economic environment, the agility concept, the integration of agility into supply chains, SMEs and associated underlying theoretical concepts that have been put forward. It is important to provide an overview of the key areas of consideration and to subsequently highlight the gap from which the research will continue – predominantly based around agility, agile supply chains and SMEs.

The agility concept has failed to attract a unilaterally accepted definition, so for this thesis it is being accepted that agility exists in two forms - broad and focused (Sherehiy *et al.,* 2007). It is also being recognised that agility aims to save money through lean production principles (Lucio, 2013) and to

control uncertainty and change (Dove, 1993; Goldman *et al*., 1994; Plonka, 1997; van Hoek *et al*., 2001; Sharifi and Zhang, 2001; Zhang and Sharifi, 2007; Pilbeam *et al*., 2012) through being knowledge driven and customer focused, often operating within virtual environments, thus improving competitiveness.

The agility concept has been adopted and integrated into supply chains, with agile supply chains being those that become reactive, flexible and innovative. Rather than working with the risk associated with multiple suppliers, agile supply chains work to share the risks and rewards with all supply chain members to improve their competitive advantage. This situation was progressed by Ismail and Sharifi's (2006) framework for agile supply chains so as to quickly respond to market prospects through an organised approach, developing both the supply chain and the product at the same time, whilst allowing other factors to interact within the system.

These models have historically been strategic in approach, yet Ismail and Sharifi (2006) considered both the strategic and operational aspects of the situation with the notions of *supply chain design* and *design for supply chain*, eliminating unnecessary product features in line with the resource and capability limitations of supply chain members. At the same time Sharifi *et al.,* (2006) aligned supply chain and product design in the *agile supply chain development framework*.

Sharifi *et al.,* (2009) strategically developed this further by assimilating products with supply chain design in the framework for agile, future-proof supply chains. This was developed further by Ismail *et al.,* (2011) into the strategic agility framework stages model, illustrating the stages an organisation would go through to become agile. This was advanced again by Sharifi *et al.,* (2013) with the *extended Ansoff matrix*.

So as to lessen vulnerability relative to their larger counterparts, attention has turned the agility and agile supply chain concepts towards SME affiliation to reduce risk and improve strategic performance – an important and necessary step due to their economic significance allied against the financial might of MNEs. Yet despite the need for agile supply chains within SMEs and the framework models that exist, there is no definitive model to support their implementation (van Hoek, 2005; Jain *et al.,* 2008; Vinodh and Prasanna, 2011; Sangari *et al.,* 2015). Furthermore, the theories and models that exist are fragmented and yet to be substantiated (Eckstein *et al.,* 2015).

It is from this position that the research gap emanates and will be considered in more depth in Section 3.2 (Page 64).

3.0 Theoretical Framework

The significant points of learning emanating from the literature review focus upon agility, supply chains, agile supply chains, SMEs, product features, the environment and responsiveness. Relevant framework models have been used to draw these themes together, yet despite their benefits they fall short in terms of practical implementation within organisations in general and SMEs in particular (van Hoek, 2005; Jain *et al.,* 2008; Vinodh and Prasanna, 2011; Sangari *et al.,* 2015).

The outputs from this research are expected to bridge this gap through advancing the existing and considered frameworks and providing a practical tool to assist SMEs in the implementation of agile supply chains, whilst at the same time adopting two other supportive models to consider product features and supply chain partner selection. This chapter discusses the framework models underlying this research, explains the knowledge gap emanating from them and advances the notions therein towards the development of the proposed process model for introducing agility into SME supply chains. Key components of the proposed approach include the PFS (Present Functioning State) Model and the adopted supporting tools, redesigned to fit the objectives and targets of the research, will be explained in detail.

3.1. Key Framework Models

Whilst numerous points were considered within the literature review, the key framework models considered that underpin this research are:

1. **The Agility Road Map (Ismail *et al.,* 2006)**

The agility roadmap process was developed to assist in developing the plans and tools required for agility implementation and monitoring. Through the identification and measurement of the relationships between strategic priorities and organisational capabilities, this model is the fundamental starting point from which this thesis is based, utilising measurements relating to delivery, cost, quality, performance, flexibility, innovativeness and service. It is an important development in the literature field in as much as it progresses the argument beyond the need for the development of agile supply chains and provides a path through which agile supply chains can realistically be developed. Furthermore, the agility roadmap

process model advocates the need for close integration of product design and the supply chain whilst carefully linking them for strategic organisational growth. This is supported by the framework for agile, future-proof supply chains (Sharifi *et al.,* 2009).

2. The framework for agile supply chains (Ismail and Sharifi, 2006)

This balanced framework advocates product design and innovation in line with supply chain design, development and management, to enable swift responses from agile supply chains in line with market needs. This effectively integrates supply chain design and design for the supply chain theories.

3. The Strategic Agility Framework (Ismail *et al.,* 2011)

Advancing upon the previous frameworks, the strategic agility framework considers the stages an organisation would be expected to work through, thus taking the conceptual frameworks closer to practical application.

4. The extended Ansoff matrix (Sharifi *et al.,* 2006; Sharifi *et al.,* 2013)

Whilst the Ansoff matrix considers the products to be sold aligned with the strategy required to achieve market growth for a given organisation, the extended Ansoff matrix forces organisations to consider product requirements in light of the needs of the market and the supply chain as a whole, thus ensuring the true needs of new products and services are considered carefully throughout the entire supply chain network.

Whilst tools such as the MBNQA and EFQM were considered in the literature review, they are primarily company assisting performance measurement tools and do not clearly align with agility or agile supply chains, and are therefore not seen as supporting framework models for this research.

There is therefore a set of literature-based principles that have been established to develop and deliver agility within organisations. From these key established perspectives, the next stage in this thesis is to identify the knowledge gap from which the rest of the research can be based.

3.2. The Knowledge Gap

The framework models considered thus far have concentrated upon agility and agile supply chains from a strategic and theoretical perspective and have predominantly been applicable to larger organisations (Ghobadian and O'Regan, 2006), thus restricting their benefits for smaller companies. Despite their presence, the difficulty faced in the practical development of agile supply chains is that no systematic or definitive model or tool exists to support their implementation (van Hoek, 2005; Vinodh and Prasanna, 2011; Sangari *et al.,* 2015). Furthermore, only a limited number of publications have considered agile supply chain enablers, drivers and other points of influence (Sangari *et al.,* 2015). Additionally, only a limited number of tests have been conducted regarding agile supply chain characteristics and benefits (Blome *et al.,* 2013) and the theories that do exist regarding the effects of supply chain agility and adaptability are disjointed and yet to be substantiated by theory or field studies (Eckstein *et al.,* 2015).

Whilst no definitive implementation model exists, other models have been advocated with various authors considering the practical progress and development of agile supply chains through different methods. Christopher and Jüttner (1999) advanced a model for managing supply chain relationships. This was effectively supported by Van der Vorst and Beulens' (2002) conclusion that it ought to be possible to redesign the supply chain to ensure it is configured and controlled, operating as an information system with an organised structure of governance.

Christopher (2000) considered the key characteristics of agile supply chains and Gligor *et al.,* (2013) deliberated the factors contributing towards agility. Authors such as Power *et al.,* (2001) considered factors contributing to organisations being more or less agile and Kisperska-Moron and Swierczek (2009) developed networks to consider agile supply chain drivers. Agile supply chain enablers were considered by Swafford *et al.,* (2008) whilst Liu *et al.,* (2013) and Gligor and Holcomb (2012) contemplated agile supply chain performance characteristics and logistics. Jain *et al.,* (2008) deliberated upon the use of fuzzy intelligent agents and Costantino *et al.,* (2012) and Pan and Nagi (2013) presented mathematical models to help in the development of agile supply chains networks, thus providing an overview of key points to be considered when developing such a supply chain.

With these points in mind, the research gap is based upon the neglected practical application of agile supply chains within SMEs from an operational perspective. The need therefore is to extend the line of research in this area and develop effective approaches to introduce and implement agile supply chains into SME organisations (Ismail *et al.,* 2011) to improve their competitiveness (in line with Sull, 2009).

In acknowledging the lack of a practical agile supply chain development framework tool, another knowledge gap arises from the need to identify their design and development needs. These have been considered by a number of authors including the agile supply chain model by Lin *et al.,* (2006), Ismail and Sharifi (2006) who considered product design in line with agile supply chains and Baramichai *et al.,* (2007) who developed a transformation matrix to achieve supply chain agility. Li *et al.,* (2008) considered agile supply chain design and constructed a theory-based model around it. Jain *et al.,* (2008), Vinodh and Prasanna (2011) and Samantra *et al.,* (2013) also advanced work in this area through considering agile supply chains attributes.

Each framework model has its benefits, but they are practically challenging for organisations to operationally implement and subsequently use to develop agile supply chains. It is possibly more difficult for SMEs to utilise them due to the lack of resources available (Ahmad *et al.,* 2012). Furthermore, they present additional challenges, the most notable being the technology required to ensure they work effectively is still being developed (Jain *et al.,* 2008; Vinodh and Prasanna, 2011). Moreover, developing a true agile supply chain is strategically challenging. It is quite a leap from operationalising and ensuring *one* organisation works effectively to considering supplier coordination and relationships to warrant the agile supply chain works as a whole – particularly whilst in the midst of economically unsettled times (Christopher and Holweg, 2011). Cooperation is therefore required between involved parties to bring agile models to practice, the achievement of which presents another element of the knowledge gap.

According to Goldman *et al.,* (1995), Christopher (2000), and Van Hoek *et al.,* (2001), for an organisation to be agile, the supply chain requires the characteristics or enablers (Lin *et al.,* 2006) of marketing or customer sensitivity, cooperative relationships, process and information integration. Braunscheidel and Suresh (2009) argue similar points, requiring agile organisations to operate from the standpoint of market behavioural characteristics and learning alignment – a point supported by Gligor and Holcomb (2012).

Sharp *et al.,* (1999) and Christopher (2000) contend that organisations should aspire to four capabilities to achieve agility - responsiveness, competency, speed and flexibility or adaptability. Chiang *et al.,* (2012) also considered agile supply chain flexibility to be important in line with strategic sourcing. Christopher (2000) and Lin *et al.,* (2006) argued for agile supply chains to be virtual and network based, have process integration and be sensitive to market needs. Akkermans *et al.,* (1999) considered *supply chain integration* – arguably an important element of supply chain *agility* – and highlighted the needs of it as being cooperation, collaboration, information sharing, trust, partnerships, shared technology and a move away from managing individual processes to managing an entire integrated chain of processes. Yang (2014) adds to this line of argument, considering technical and relationship factors and their

importance in terms of agility. Along similar lines, Swafford *et al.,* (2008), Ngai *et al.,* (2011), Liu *et al.,* (2013) and Gligor and Holcomb (2014) highlighted the need for IT as a means to integrate and coordinate the information required in an agile supply chain. Such integration factors are another element of the knowledge gap.

To maximise the efficiency of collaborating partnerships, the introduction of e-capability or virtual supply chains was advocated by Christopher (2000) who argued that such a tool would be needed to help build profitable organisations, the supposition hereby being that organisations operating in this way would be able to retrieve accurate, transparent and timely data, and have access to reports and stock management information across the entire supply chain network. To achieve this, Esper *et al*., (2010) suggested virtual supply chains would need to operate hand-in-hand with robust information systems, adding that supply chain and marketing processes improve through the collaborative procurement and dissemination of market and supply chain information, delivering benefits over less cooperative supply chains. The ability to identify effective collaborative supply chain partnerships is therefore another element of the knowledge gap.

Debatably, these factors create a challenge – the question arises as to how a highly complex supply network (starting from yet-to-be-mined ore or crops) that must be market sensitive, virtual, network based and process aligned (Harrison *et al.,* 1999) can undergo a potentially innumerable set of change processes whilst dealing with volatile markets and uncertainty? Whist automated models for managing organisational resources (such as MRP and ERP) have assisted, this challenge postulates the need for a model that not only manages to overcome these issues, but one that will predict outcomes within specific limitations that might not yet be known. In a bid to tackle the issue of uncertainty, Van der Vorst and Beulens (2002) proposed the need for:

- A set of clear objectives within the supply chain
- A set of performance indicators that tie back into the objectives such that the success or otherwise of the objectives can be identified
- The ability to approximate future situations within the supply chain
- Information relating to the present state of the supply chain
- The abilities for the supply chain as a whole to be able to handle the tasks assigned
- The capacity for the supply chain to be able to consider potential impacts if different courses of action are taken
- The ability to maintain control within the supply chain

The Supply Chain Council's SCOR (Supply Chain Operations Reference model) reference model highlights the importance recognised in managing supply chains. It considers interactions between members to enable effective supply chain management based around the five key functions of Plan, Source, Make, Deliver and Return (SCC, 2001). Agile supply chain models are slightly different though and move away from the physical design of the supply chain and place emphasis on aligning strategic and operational factors to affect the outcome (Ismail and Sharifi, 2006). Supply network strategic and operational alignment is therefore necessary, and needs to be in line with the needs of the market – anyone or anything employed within the supply network must be adding value. Arguably, any aspect of the supply chain failing to add value should be eliminated, a point supported by Baramichai *et al.,* (2007) who postulated that in order to develop and allow for new supply chain competencies, organisations must be fully integrated to react to fickle markets that are prone to short term changes. Ismail and Sharifi (2006) argued that it should be possible to design processes, products and manufacturing into the supply chain design at the same time. This ability to align strategic and operational factors alongside market needs presents another element of the knowledge gap.

In summary, the knowledge gap being addressed in this thesis identifies:

- The lack of an agile supply chain framework practical implementation model.
- The lack of models to identify agile supply chain design and development needs in line with market demand and other external business factors, with particular reference to the needs of SMEs.
- The need for considering integration, coordination, collaboration and alignment of strategic and operational factors with market needs in such models.

In acknowledging the lack of implementation tools for agile supply chain development (particularly for SMEs), and the knowledge gaps discussed above, a model has been developed and will subsequently be explicated.

3.3. Approach to Model Development

At this point, key models have been considered highlighting frameworks and processes through which agile supply chains can be strategically developed for organisational use. Alongside these models, the knowledge gap has been identified and discussed and can be summarised as being the lack of a practical tool with which to implement the frameworks.

The proposed tool with which to bridge the knowledge gap is termed as the PFS (Present Functioning State) Model, developed with consideration of the key elements from the framework concepts identified in the literature review, the recognition of the existing knowledge gap and the subsequent building of a working model to support SMEs in their incorporation of agility into their supply chains.

The point of initiation in developing SME agile supply chains requires them to be clearly aware of their means of operation relative to the internal and external environments, which as argued so far must be a key feature of any model built to assist the agile supply chain development process.

Having identified its present operating state, attention turns to the product offering and the features therein as well as the supporting supply chain to meet customer needs (in line with Yauch, 2011) in less time (Hasani *et al.,* 2012). Models must be adopted to identify the most suitable product features as well as appropriate supply chain partners to ensure maximum knowledge sharing takes place throughout the supply chain as a whole (in line with Simchi-Levi *et al.,* 2002). Such supply chain partners must be both attractive to work with and attracted to working in the supply chain situation (in line with Mortensen *et al.,* 2008) – particularly given the vulnerability SMEs face (Vargo and Seville, 2011), the rationale to work with interested parties is paramount (in line with Schiele, 2006). These arguments fall in line with Sharifi *et al.,* (2009) and the interactions between the *Four Dimensional Factors of Attractiveness.*

This chapter considers the approach adopted for each of these elements as well as the means through which implementation can be considered via a roadmap. A pragmatic overview of this is illustrated in Figure 3. 1.

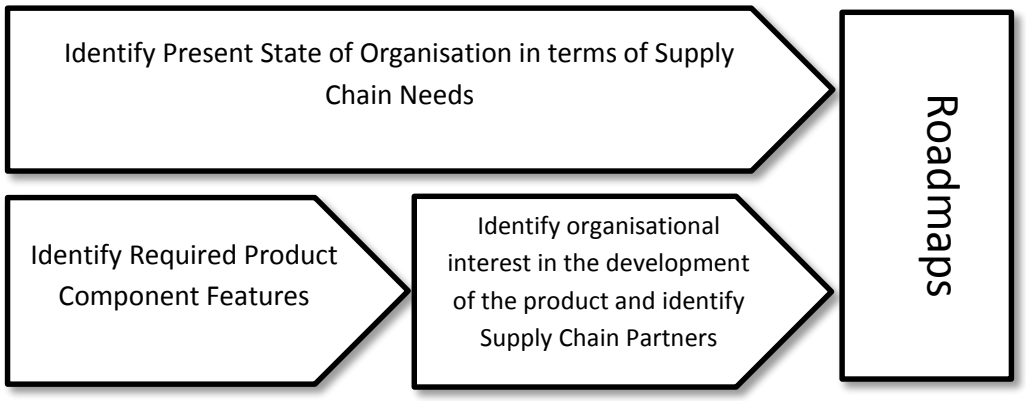


Figure 3. 1 - Conceptual Model Overview (Author)

The approach shown is comprised of three key aspects, detailed in the following, which once compiled would lead to the development of a roadmap to guide the transformation process for the firms through the adoption and application of the three sections:

a. The development of a model to analyse the present state of factors affecting the supply chain within SMEs (the Present Functioning State or PFS Model). This requires data to be collected through a questionnaire-interview to ascertain an organisation's operating perspectives in the fields identified in Figure 3. 2.

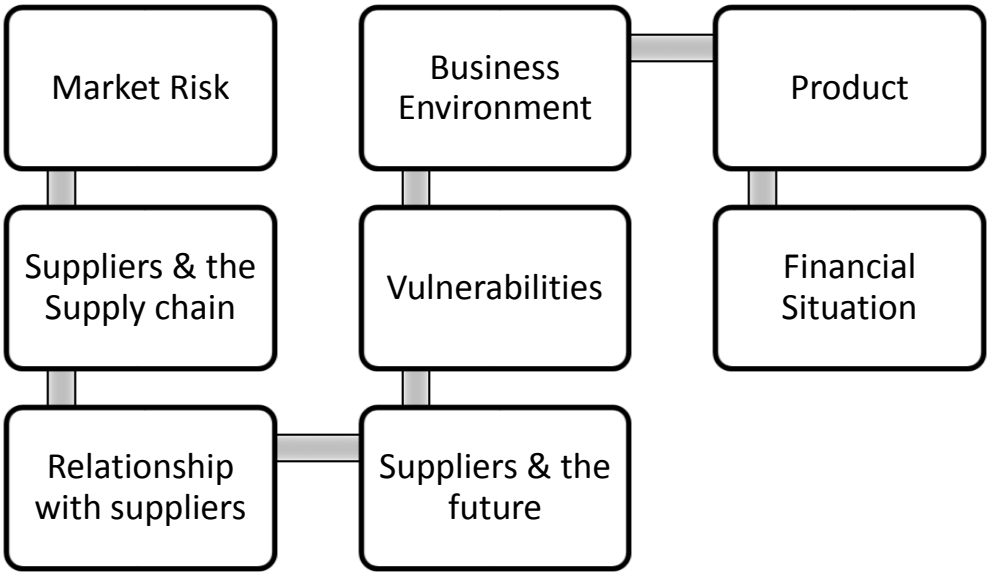


Figure 3. 2 – Representation of Data Entry into PFS Model (Author)

b. The identification of product component features that customers and end users require through the use of Conjoint Analysis, which is discussed in the following sections.
c. The identification of organisational capability in developing a product or in continuing to produce a product whilst at the same time identifying supplier organisations that the parent organisation could work with and would be interested in being a member of the said supply chain. This will be achieved through the use of Repertory Grid Analysis and will be discussed further later in this chapter.

It is important to note that the Conjoint Analysis and the Repertory Grid Analysis are being used as a means to support the PFS Model through quantitative methods. Through ascertaining the features required in a product and the attractiveness of potential supply chain partners, the overall task of developing an agile supply chain becomes easier for the organisation in question. Armed with the knowledge derived from the Conjoint Analysis and Repertory Grid Analysis the organisation is better placed to consider the results from the PFS Model and move forward.

The process as a whole has been designed for ease of use without the author being present, utilising a questionnaire proffering options for selection by the user to gather data for the PFS Model and simple data-gathering tables for the Conjoint and Repertory Grid Analyses.

The roadmap to implementation process suggested within this thesis as an outcome from the application of the PFS Model and its accompanying tools, presents an outline methodology an SME can practically follow to develop its agile supply chain, designed to incorporate each of the areas covered by the PFS Model. These roadmaps are broad in their approach and have been designed such that an SME can understand the all-encompassing areas that should be considered in their development. However, it is envisaged that to make practical use of such roadmaps, more bespoke versions would be required for each individual SME, which would possibly require training and development for those involved.

The methodological data gathering process outline for this study as a whole, incorporating the PFS Model, the Conjoint Analysis and Repertory Grid Analysis is illustrated in Figure 3. 3. Having considered a broad overview of the key approach to the model development, each element of the model will now be considered in turn.

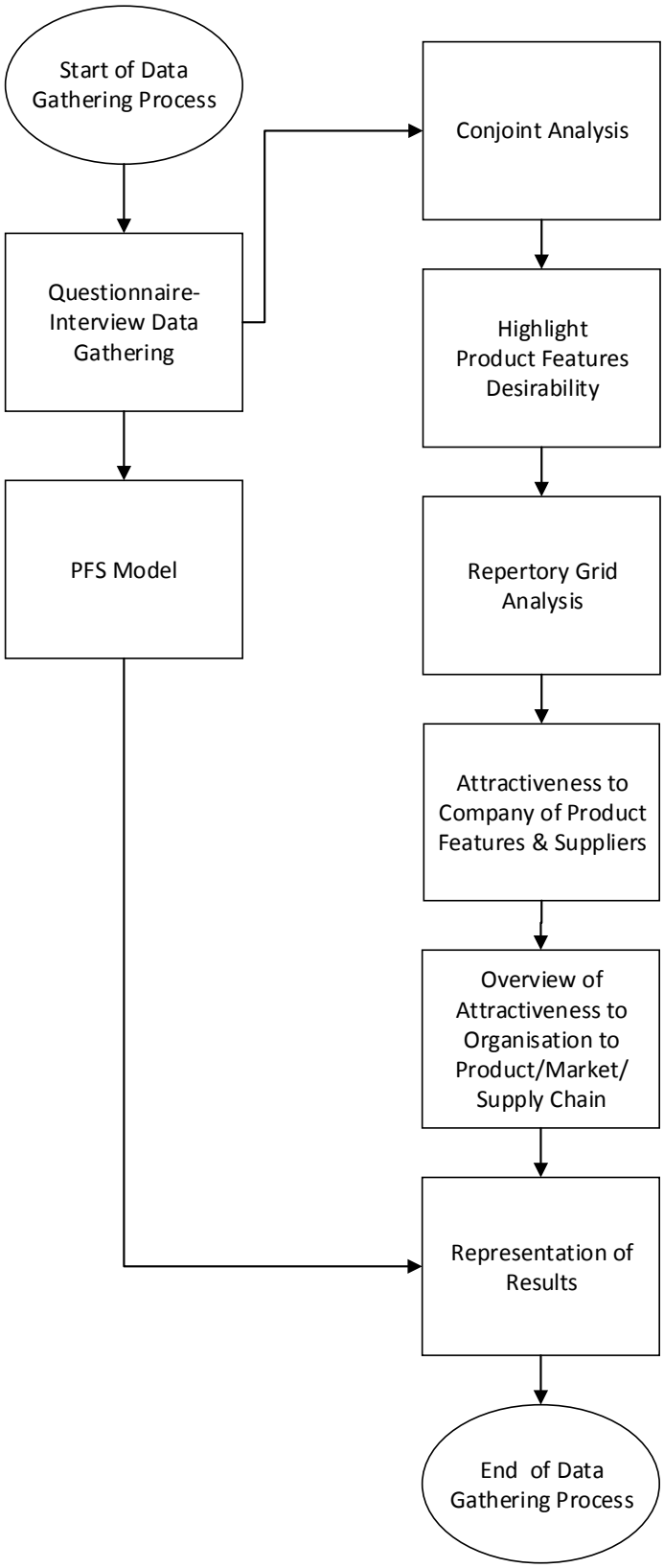


Figure 3. 3 - Data Gathering & Model Implementation Process (Author)

3.4. PFS (Present Functioning State) Model Development

The *PFS* (Present Functioning State) model highlights the relative capabilities and *ascertains the present operating state of an organisation wishing to develop its agile supply chain from a diagnostic (and not benchmark) point of view*. Having identified its functioning position, the organisation can work towards making improvements and changes to areas requiring attention.

Identification of an organisation's functioning position is achieved through the completion of a questionnaire (presented in Appendix A, page 380) in case study organisations – the outputs of which are entered into the PFS Model. The questions therein fall under eight key areas of supply chain importance, the rationale for which is illustrated in Table 3. 1.

Table 3. 1 - Overview of PFS Model Questionnaire Areas (Author)

PFS Questionnaire Area	Description	Rationale for Questionnaire Areas
Market risk	The perceived market risk the organisation in question considers it faces both now and in the foreseeable future	Rationale for inclusion in model originates from Ansoff (1965) and Sharifi *et al.,* (2013)
Suppliers and the supply chain	The perceived awareness of suppliers, their organisational objectives and levels of interaction with the supply chain as a whole. The receptiveness of the organisation and partners to new practices.	Rationale for inclusion in model originates from Ismail and Sharifi (2006)
Relationship with suppliers	The perceived relationship with suppliers	Rationale for inclusion in model originates from Ismail and Sharifi (2006)
Suppliers and the future	The perceived relationship with suppliers in the future	Rationale for inclusion in model originates from Ismail and Sharifi (2006)
Vulnerabilities	Vulnerabilities to the supply chain that might exist (e.g. transportation, legal, social, negative publicity, personnel loss)	Rationale for inclusion in model originates from Ismail and Sharifi (2006).
Business Environment	The perceived organisational awareness of the financial environment and its interactions therein	Rationale for inclusion in model originates from Ismail and Sharifi (2006).
Product	Perceived factors affecting the products made by the organisation and their success	Rationale for inclusion in model originates from Ismail and Sharifi (2006) and Sharifi *et al.,* (2009)
Financial Situation	The perceived organisational awareness of both micro and macro factors of economics and their impact on production	Rationale for inclusion in model originates from Ismail and Sharifi (2006)

Each answer from the questionnaire is allocated a linear weighting (against, for example, the possible answers of *Low, Medium or High*) within the PFS Model. The weightings for each answer are illustrated in Table 3. 2.

Table 3. 2 - Illustrating weightings used in the questionnaire/spreadsheet result calculations (Author)

Type of Question	Potential Answer	Weighting
Positively based Y/N Questions	Y	+3
Positively based Y/N Questions	N	-3
Negatively based Y/N Questions	Y	-3
Negatively based Y/N Questions	N	+3
Low/Medium/High option based questions	L	1
Low/Medium/High option based questions	M	3
Low/Medium/High option based questions	H	5
Negatively based A/B/C/D option questions	A	1
Negatively based A/B/C/D option questions	B	2
Negatively based A/B/C/D option questions	C	3
Negatively based A/B/C/D option questions	D	4
Positively based A/B/C/D option questions	A	4
Positively based A/B/C/D option questions	B	3
Positively based A/B/C/D option questions	C	2
Positively based A/B/C/D option questions	D	1

When all questionnaire answers are entered into the PFS Model, an overall *PFS Score* is derived for each area of output (illustrated in Figure 3. 4).

QUESTIONNAIRE AREA	Organisation X PFS SCORE	POTENTIAL SPREAD			Organisation X % DEVIANCE from MID Point	Organisation X DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	69	7	59	111	117%	10
Suppliers / Supply Chain	53.1	-18	15	48	354%	38.1
Relationship with Suppliers	10	-14	18	50	56%	-8
Suppliers & future	28	-106	7	120	400%	21
Vulnerabilities	-89.5	-215	-100	15	90%	10.5
Business Environment	-6	-18	-3	12	200%	-3
Product	3	-120	-1.5	117	-200%	4.5
Financial Situation	51	-31	11	53	464%	40

Figure 3. 4 - Example PFS Model Score Output (Author)

An overview of the resultant model outputs in Figure 3. 4 is illustrated in Table 3. 3.

Table 3. 3 – Overview of the Resultant Model Outputs (Author)

Questionnaire Area	Relates to the explanations in Table 3. 1 (page 73).
Company's PFS Score	The accumulated total of the linear weighted answers from each *Questionnaire Area* from the questionnaire-interview responses, as explained in Table 3. 2 (page 74).
Potential Spread from Responses	The possible minimum and maximum accumulated totals for each of the *Questionnaire Areas* – derived from the linear weighted answers from questionnaire-interview process. The *minimum* total is the accumulated total of the lowest possible score achievable from the answers in each *Questionnaire Area*. The *maximum* total is the accumulated total of the highest possible score achievable from the answers in each *Questionnaire Area*. The rationale for these criterions is to illustrate the spread of a company's PFS score.
Company's % Deviance from MID Point	The percentage deviance or difference between the PFS Score and the middle point of the potential scores as a percentage.
Company's Deviance from MID Point	The deviance or difference between the PFS Score and the middle point of the potential scores.

It is important to note that this is a diagnostic and not a benchmarking tool and that the data set from each organisation is unique and cannot as such be compared (directly at least) to a data set from another organisation. The outputs are all *relative* to the *mid-point score* and accordingly can only be considered from this standpoint. Furthermore, the results should not be considered to be *absolute* – moreover they should be considered to be indicators of the present functioning state of the organisation relative to the mid-point score and the key indicators of supply chain agility. The only possible comparison that could be drawn between organisational results is that one might have achieved more success factors than another according to the PFS Scores. This in itself is an anomaly though – one organisation's supply chain agility cannot achieve the same targets and goals as that of another organisation as they have different targets, goals and needs, and therefore a true comparison cannot be made.

The significance of a score comes about when considering it relative to the potential spread of scores available to each output area. The *deviance* from the mid-point of the answer scale is an indication of whether the organisation in question considers itself to be in a positive or negative light relative to the questions asked. Any result showing an outcome that is larger than the *mid-point* indicates the organisation has a relative *strength* in that field. Conversely, negative outcomes indicate a relative *weakness.* From these results an SME can determine the areas it needs to concentrate on in order to develop its agile supply chain, starting with the area deemed to be relatively weakest and progressing through to the area of highest relative strength.

Having illustrated the output data statistically, the *PFS* Score results are compiled into a bar chart by the model, illustrating the relative capabilities of the different output factors for the organisation in question (an example of which is illustrated in Figure 3. 5).

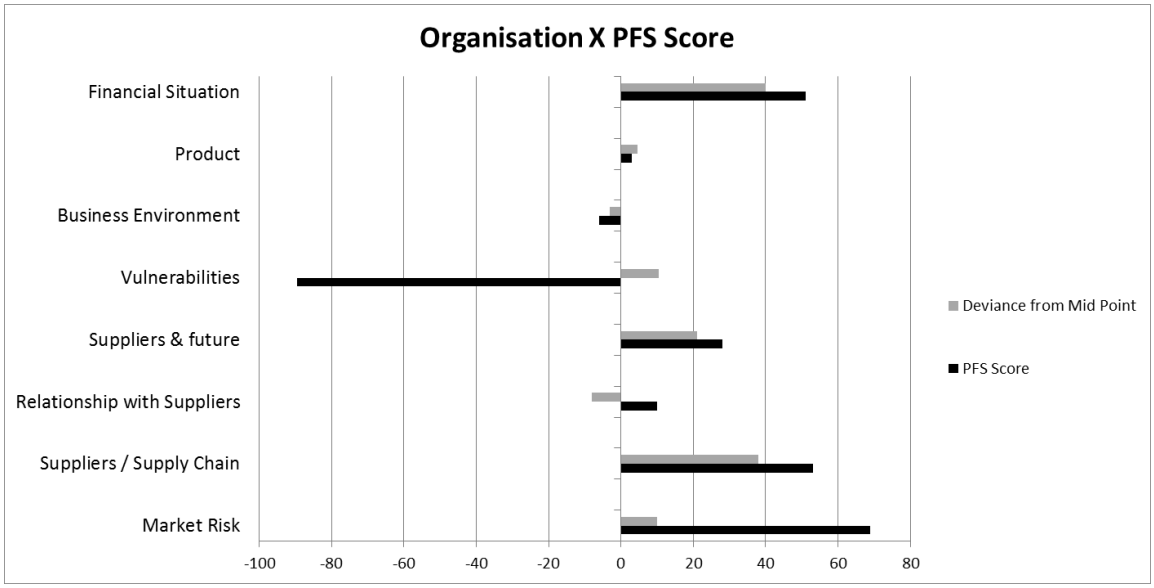


Figure 3. 5 - Example PFS Model Score Results (Author)

3.5. Identification of Product Features

Discussions and tools relating to product features were considered in the Literature Review chapter and statistical analytical tools have been advocated by authors such as Kotler (1999), Billeter *et al*., (2011) and Lakshmanan and Krishnan (2011). Table 3. 4 illustrates some such relevant tools.

Table 3. 4 - Statistical Tools for use in Product Feature Determination (Author)

Statistical Tools	Models	Reference
Multiple Regression Analysis	Defines the linear correlation between given sets of variables.	Pal and Bhattacharya (2013)
Discriminant Analysis	Statistical tool to establish data variables that discriminate between two or more groups.	Dincã *et al*., (2014)
Factor Analysis	Condenses large data sets into practicable and manageable quantities.	Pinches *et al.,* 1973
Cluster Analysis	Finds data patterns and configurations via a matrix of variables, scoring and grouping according to similarities in their scores.	Saunders, 1980
Conjoint Analysis	Identifies product characteristics relative to customer requirements through modelling decisions.	Banerjee and Agarwal, 2013
Multidimensional Scaling	Visualises relationship levels for specific dataset incidents.	Desarbo and Manrai, 1992
Differential Calculation	Considers the rate of change of entities.	Steingartner *et al.,* 2013
Fuzzy logic	A technique allowing for the identification of degrees of truth between variables, safeguarding logic in decision-making.	Poplawska *et al.,* (2015)

Consideration of these tools is necessary to ascertain the most suitable for product feature determination. An overview for this is presented in Table 3. 5.

Table 3. 5 - Tools used in Product Feature Determination (Author)

Tools	Potentially Relevant to this Study?
Multiple Regression Analysis	No – correlation not required in study
Discriminant Analysis	No – data discrimination not required in study
Factor Analysis	No – large data sets not under consideration
Cluster Analysis	No – data patterns and variables not required in study
Conjoint Analysis	Yes – fits within the agility features of the research (in line with Ismail and Sharifi (2006) and Ismail and Sharifi (2013)
Multidimensional Scaling	No – relationship levels not under consideration
Differential Calculation	No – change not under consideration
Fuzzy logic	Yes

Of the product feature determination tools available and of potential use herein, Conjoint Analysis and Fuzzy Logic provide potential opportunities for inclusion in the work for this thesis. Fuzzy Logic offers the ability to apply clear-cut reasoning to areas of fuzziness and imprecision (Zadeh, 2008). Its use incorporates the benefits of the use of semantic variables and insights, generalisation, computation with words and imprecision, and can be used as a modelling language (*ibid*). Whilst there are clear benefits to using fuzzy logic, for the purposes of this thesis it has not been used as semantic variables, insights and generalisations are not being considered (data specific outcomes are required).

By comparison, Conjoint Analysis considers the attributes of a product and reflects upon how they affect customer needs (Levy, 1995). The tool calculates the level of trade-off between one product attribute and others and subsequently provides a macro-perspective on how combinations of attributes affect customer opinions of products as a whole (Hobbs, 1996).

Conjoint Analysis has been applied to numerous business segments such as credit cards (Kara *et al*., 1994), financial services (Arias, 1996), UK beef retailing (Hobbs, 1996) and in the identification of relevant attributes in restaurants (Koo *et al.,* 1999). It has also been used in the medical profession (Ryan and Farrar, 2000) to highlight patient health care preferences and in understanding user views of management information systems (Lee and Rhim, 2014) such that usability and user satisfaction are maximised. The outputs from such studies provided opportunities to design future products more closely around user requirements, thus making the experiences more effective and efficient for all involved.

In effect, Conjoint Analysis considers the decisions made during the process of choosing between products and features. By considering how much each feature is required relative to another, the tool can calculate the relative importance for the trade-offs made (Toombs and Bailey, 1995). Once the relative importance of the features are established, it is possible to eliminate the less popular features from a product and concentrate on the development of higher ranking ones. The tool statistically identifies a value for each product feature for a customer and then provides a ranking of the said features (Levy, 1995).

From the standpoint of an agile supply chain this line of thought is vital. When developing an agile supply chain there is clearly a need to establish not only the product but also the key features required within the said product such that only relevant suppliers are involved in the development and supply chain for its manufacture, thus eliminating unnecessary costs and time.

Subsequently, it was concluded that Conjoint Analysis (a tool to assess product feature characteristics relative to consumer likings (Sarlin *et al.,* 2015) and often used in market research (Caldwell, 2015)) is the most suitable instrument to use for the work conducted in this thesis. It has been chosen as it is recognised as being rigorous and consistent in preference selection, and assists in decision making and highlighting feature trade-offs (Ryan and Farrar, 2000). It can help solve real-world marketing problems (Louviere *et al.,* 2010) and clusters buying behaviour (Smith, 1956), which in turn can assist in managing customer relationships. Clustering allows for not only the marketing of products and services to appropriate groups but also permits further consideration of differences between those meeting cluster profiles (Sarlin *et al.,* 2015). It also provides greater consistency than other variant assessment tools (Arias, 1996). Accordingly, a conjoint analysis was built into a spreadsheet model to analyse the key features of a product and to illustrate the relative importance of each feature.

In line with the points made by Ammirati (2003), this Conjoint Analysis model has been limited to three key product features for analysis (so as not to overwhelm users with the choice of options and in line with Wu *et al.,* 2014). An example of this is illustrated in Table 3. 6. Here, three product feature choices have been considered – feature A (x,y,z), feature B (red, blue, green) and feature C (5mm or 10mm). All possible configurations for the three feature options have been illustrated (e.g. x, red, 5mm; y, red, 5mm; z, red, 5mm etc.). The customer (or Business to Business decision maker) ranks the importance of each of the feature configurations relative to one another and the Conjoint Analysis calculates desirability scores for them, illustrates the desirability of the features relative to the mid-point of the desirability scores and concludes as to whether or not the feature combinations are desirable or feasible with a 'yes/no' output.

Had the Conjoint Analysis model been built using five factor choices, the number of option choices available would increase dramatically. Mathematically this is shown as $2^2 3^3$ which provides a total of 108 possible combinations of choice which is arguably too many for a respondent to choose from – the volume of options simply becomes too large to deal with (Wu *et al.,* 2014).

Table 3. 6 - Example Conjoint Analysis Model (Author)

Product Features				Customer Ranking of Feature Variable	Desirability Score	Desirability (Difference from Mid Point)	Feasible / Desirable Combination?
A	B	C					
X	Red	5mm		1	9	4	Yes
Y	Red	5mm		4	6	1	Yes
Z	Red	5mm		5	5	0	Yes
Z	Blue	10mm		7	3	-2	No
Z	Green	5mm		9	1	-4	No
Y	Blue	10mm		6	4	-1	No
Y	Green	10mm		8	2	-3	No
X	Blue	10mm		2	8	3	Yes
X	Green	5mm		3	7	2	Yes

It is essential to note from Table 3. 6 that four of the input combinations are not deemed to be desirable and from the organisation's perspective at least, should not be considered as viable options for the development of an agile supply chain or production.

A number of methods of calculating Conjoint Analysis have been put forward including Orme (2009) who presented a mathematical expression for the model. For the benefit of this thesis and the building of the model into a spreadsheet it was decided to make use of the template suggested by Kahn (2006) due to its simplicity of design for spreadsheet model development (which would enable potential respondents

to make alterations in future uses of the model) and due to it highlighting the relative importance of feature dimensions within the model.

The model utilising Kahn's (2006) template works as follows:

1. Key product features are entered into the model.
2. The respondent ranks preferences for the feature combinations in the model (during the data gathering process relating to this section of the model, no attempt was made to influence answers relating to the Conjoint Analysis after consideration of Jaeger *et al.,* (2000)).
3. The model calculates a *desirability score* based upon the customer rankings and continues to calculate the difference between the score given and the mid-point of all the scores.
4. The model calculates whether or not a combination is feasible or desirable for the organisation to continue with its manufacture.
5. The model considers the importance of each feature relative to the rankings given and provides an overall output of *relative importance of each feature dimension*, thus illustrating in percentage terms the most popular combination on offer.

Further to these key points, a spreadsheet model was built upon the following basis:

1) 3 features are built into the model, illustrated as A (Brand), B (Colour) and C (Size).
2) For each feature, factorial variations of the feature combinations are presented (e.g. under *Brand* the feature variations are x, y and z). In this example there are nine possible combinations for each of the variations presented.
3) The customer provides a ranking of the most appropriate combinations of the features – the order in which the features are most desired.
4) *Desirability Scores* are presented within the model on the basis in this example of 1 to 9. The model converts the customer rankings into *desirability scores* – a customer ranking of '1' is awarded the highest desirability score of '9' in this example.
5) The model calculates the difference between the *desirability scores* and the midpoint value of the *desirability scores* (for example the midpoint value between the numbers 1 and 9 is 5. A *desirability score* of 9 is subtracted from the midpoint value of 5 to provide a *desirability factor* of 4).
6) The model calculates whether or not this *desirability score* of the feature combinations is feasible or desirable. Any combination that has a score of less than 0 is deemed to be unsuitable and is therefore not feasible or desirable. The model illustrates this through a simple 'yes/no' statement.

The spreadsheet example of the Conjoint Analysis is illustrated in Figure 3. 6 (the spreadsheet calculations for which are shown in Appendix B, page 407.

Features						
A	B	C	Customer Provided Ranking of Combinations	Desirability Scores	Desirability (difference from midpoint value)	Feasible / Desirable Combination?
x	Red	5mm	1	9	4	Yes
y	Red	5mm	4	6	1	Yes
z	Red	5mm	5	5	0	Yes
z	Blue	10mm	7	3	-2	No
z	Green	5mm	9	1	-4	No
y	Blue	10mm	6	4	-1	No
y	Green	10mm	8	2	-3	No
x	Blue	10mm	2	8	3	Yes
x	Green	5mm	3	7	2	Yes

Figure 3. 6 - Example Spreadsheet Conjoint Analysis Model (Author)

The resulting outputs in Figure 3. 7 (the calculations for which are presented in Appendix B, pages 407 and 408) show that the feature combination of *X, Red, 5mm* is the most important, with *Y, Blue, 10mm* being second most important and *Z, Green* being ranked third.

Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Total Average Desirability Score of Feature C		Relative Importance of Each Feature Dimension	
X	8	Red	7	5mm	6	A	52%
Y	4	Blue	5	10mm	4	B	34%
Z	3	Green	3			C	14%

Figure 3. 7 - Example Outputs from Conjoint Analysis Model (Author)

In the unusual instance when the feature variations for different products are the same for each product in a range (thereby making each feature the same no matter what product is under consideration), the model calculates the relative importance of the accumulated individual features in the same way, the outputs being illustrated as the relative importance of the feature variations (this minor change is necessary to differentiate between the identical feature variations and illustrate their relative importance to one another). As an example here, for the features A, B and C, each holding feature dimensions of X, Y and Z, the accumulated X, Y and Z output scores are shown as percentages relative to one another after all calculations have been completed.

3.6. Identification of Supply Chain Partners

Supporting the PFS Model in product feature selection, this research will make use of a *decision approach* tool to measure attitudes and opinions and assist management decision-making and training to determine potential agile supply chain partners. From the standpoint of agile supply chain development, a tool that can measure the potential interest of supply chain partners would assist in the process of approaching and finding relevant partners, thereby contributing in developing effective agile supply chains. Supply chain partner definitions were considered in the literature review (with reference to Rezaei *et al.,* 2015), along with consideration of the importance of partnership selection in terms of reliance (Johnson, 1999), contracts (Handfield and Bechtel, 2002), information sharing (Li *et al.,* 2006), relationship stability (Caloffi *et al.,* 2015), trust (Miquel-Romero, 2014), loyalty (Shaalan *et al*., 2013), and transparency (Doorey, 2011).

The decision support tool of choice here is Repertory Grid Analysis – a psychological tool to identify how an individual interprets an experience through measuring attitudes and opinions, that has been effectively used to assist management decisions and training (Easterby-Smith *et al.*, 1996). For this thesis, it will relate to the interpretation of the *attractiveness* to work as part of a supply chain and thereby become a partner for the creation and development of a product. It will also work in line with the *Four Dimensional Factors of Attractiveness* framework (Sharifi *et al.,* 2009).

Repertory Grid Analysis is based upon *personal construct theory* (Kelly, 1955, 1970) as the model allows the individual to articulate views of a given situation or environment with little interference from the interviewer (Caldwell and Coshall, 2002), providing a quantitative perspective to qualitative data (Eisenhardt, 1989). Whilst acknowledging that the interviewer cannot effectively interfere with responses relating to the Repertory Grid Analysis, it is important to recognise that the Repertory Grid

considers views relating to the future of products. Views put forth by individuals in the data gathering process will be influenced by experiences from the past, and individuals in the same organisation may hold different perceptions of the same matters. There is therefore *some* influence introduced into the answers derived from the tool and it is not guaranteed to produce identical results no matter who uses it (Easterby-Smith *et al.,* 1996).

Whilst there is limited evidence of the use of Repertory Grid Analysis in agile supply chain development, Goffin *et al.,* (2012) advocate its use to encourage case study interviewees to consider and evaluate supplier performance and presented a table of its use in recent years (illustrated in Table 3. 7).

Table 3. 7 - Operations research, management science, production & operations management papers based on Repertory Grid Analysis (Adapted from Goffin et al., 2012, pp. 808),

Area of Use	Authors
Product management	Yan et al. (2009)
Multiple decision making criteria	Phillips (2006)
Information resources management	Tan and Gallupe (2006)
Decision support systems	Scheubrein and Zionts (2006)
Manufacturer-supplier relationships	Goffin et al. (2006) Lemke et al. (2003)
Manufacturing processes	Duberley et al. (2000)

As this section of the research is concerned with supplier selection based upon case studies (which is in-part based upon supplier performance), there is supporting evidence to suggest that Repertory Grid Analysis is a suitable tool for use here. With this in mind, the Repertory Grid for developing an agile supply chain would need to consider agile supply chain factors relative to the product features under consideration, and highlight whether or not an organisation is likely to be interested in being part of the agile supply chain given the said factors (as illustrated in Figure 3. 8).

Figure 3. 8 - Work Flow for Repertory Grid Analysis in this thesis (Author)

Having considered the Repertory Grid Analysis concept (and building on from the Conjoint Analysis), a spreadsheet model for a Repertory Grid Analysis has been developed. This not only incorporates the notions identified by the Personal Construct Theory (Kelly, 1955) but also integrates results from the Conjoint Analysis to provide an overall model of attractiveness for products and features.

Through the use of this model, an organisation developing an agile supply chain could begin to identify potential partners in line with the market desirability of their product features. Any feature deemed to be unimportant by the market could be eliminated, whilst at the same time those features deemed necessary could be highlighted and consequently suitable supply chain partners to provide the said components for these features could be considered. The Repertory Grid effectively acts here as a means of eliminating unnecessary elements of products and the supply chain, thus improving the overall efficiency.

Agile supply chain characteristics considered in the literature review by Sharp *et al.,* (1999), Christopher (2000), Goldman *et al.* (1994), Van Hoek *et al.,* (2001), Lin *et al., (*2006), Ellegaard and Ritter (2006), Platts and Song (2010), Yauch (2011), Hasani *et al.,* (2012), Pilbeam *et al.,* (2012), Abbasi *et al.,* (2014), Poplawska *et al.,* (2015) and Eckstein (2015), as well as other more generalised considerations of supply chain requirements need to be built into the Repertory Grid Analysis model. Furthermore, factors of attractiveness (Fiocca, 1982; Olsen and Ellram 1997; Harris *et al.,* 2003) must also be anticipated. Significantly, the *Four Dimensional Factors of Attractiveness* (Sharifi *et al.,* 2009) need to be incorporated into the Repertory Grid Analysis in terms of what is attractive to suppliers, from suppliers, to the supply chain-initiating organisation and ultimately to the customer.

A list of key areas for consideration within the Repertory Grid Analysis was subsequently drawn up:

- Cost
- Time
- Effort
- Company capabilities
- Ability / capability to deliver
- Quality
- Performance
- Innovation
- Flexibility
- Service
- The need to outsource
- Consideration as to whether or not a supplier exists
- Consideration as to whether or not a specialist supplier is required in the agile supply chain
- Consideration as to whether or not a supplier will be involve in product development
- The amount of time/input required
- Supplier interest / commitment
- Supplier capability
- Supplier strength
- Attractiveness to supplier

Arguably, from a practical perspective and for an organisation that may wish to run their own Repertory Grid Analysis, it would be possible to adjust these parameters to meet their own specific requirements. From the point of view of this thesis these factors have been used and are highlighted in the process flow for the Repertory Grid Analysis that is illustrated in Figure 3. 9.

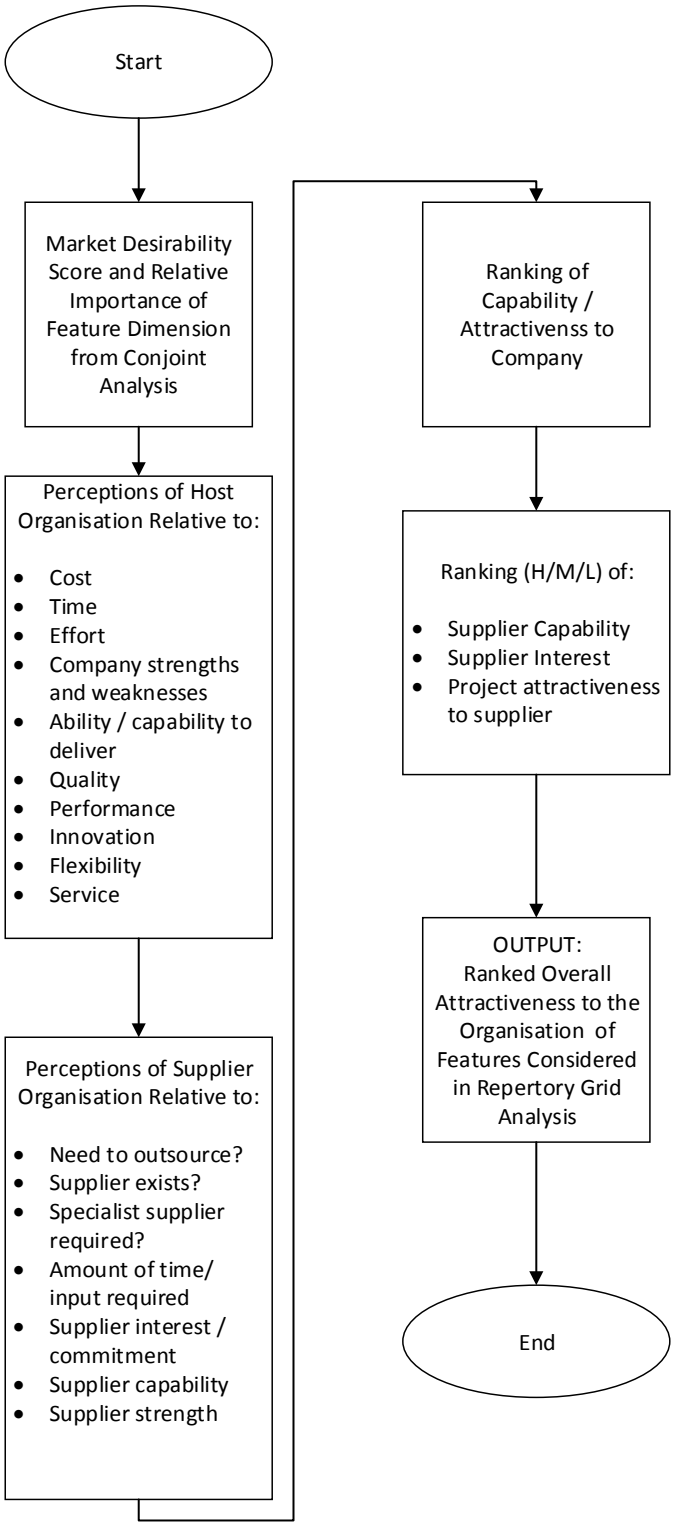


Figure 3. 9 - Repertory Grid Analysis Process Flow (Author)

In effect, the Repertory Grid Analysis considers the points highlighted in Figure 3. 9 from two standpoints:

1) The organisation developing the products and agile supply chain.
2) Suppliers or potential suppliers to the organisation developing the products and agile supply chain.

Having illustrated the outline of the Repertory Grid Analysis model, the workings of the model can now be considered.

The first stage of the Repertory Grid Analysis requires the SME that is building its agile supply chain to highlight its three most important product features (such as *A, B* and *C*), against which one option from L*/M/H* (low/medium/high) must be selected from the key areas for consideration (such as cost, time and effort, illustrated in Figure 3. 10), in line with the Conjoint Analysis rationale. The spreadsheet model assigns a corresponding value via a lookup table illustrated in Figure 3. 11 (the conversion factors for which are illustrated in Table 3. 8, page 90, and the spreadsheet lookup tables in Appendix B, pages 411 and 412). A formula calculates the total of the values for each of the product features and multiplies it by the *Desirability Score* calculated following the organisational ranking (previously used in the Conjoint Analysis). This provides a *Ranking of Capability/Attractiveness to Company* output and is illustrated in Figure 3. 10.

Our Company														
Product Features	Cost	Time	Effort	Company Capability	Ability/Capability to Deliver	Quality	Performance	Innovation	Flexibility	Service	Capability/Attractiveness to Company	Ranking Capability/Attractiveness to Company		
A	l	l	l	l	l	l	l	l	l	l	**107**	2		
B	l	l	l	h	h	h	h	h	h	h	**229**	1		
C	l	l	m	h	l	l	l	l	l	l	**98**	3		

Figure 3. 10 - Example of Repertory Grid Analysis Spreadsheet Model Internal Organisation Rankings (Author)

Lookup Values										
Product Features	Cost Lookup Value	Time Lookup	Effort Lookup	Company Capability	Ability to Deliver	Quality	Performance	Innovation	Flexibility	Service
A	20	25	15	15	6	1	6	6	6	6
B	20	25	15	3	30	5	30	30	30	30
C	20	25	9	3	6	1	6	6	6	6

Figure 3. 11 - Example of Lookup Values for Repertory Grid Analysis Spreadsheet Model Internal Organisation Rankings (Author)

Table 3. 8 - Conversion weightings used in Repertory Grid Analysis (Author)

Response Option	Spreadsheet Option Weighting
Y	1
N	0
E	3
P	5
K	3
L	1
M	3
H	5
L (For *Cost* calculations only)	5
M (For *Cost* calculations only)	3
H (For *Cost* calculations only)	1

The model now requires inputs relative to the perception of suppliers. It is important to note that the inputs here are not the views of suppliers themselves, but are the assumed views of suppliers from the point of view of the SME developing the agile supply chain. Essentially, this is a process from which the organisation developing the agile supply chain can accept or eliminate potential suppliers from the standpoint that they *may* or *may not* be interested in being part of the new agile supply chain. In line with this, the questions asked aim to establish whether or not a supplier is actually required within the agile supply chain, whether such a supplier exists and how much time and involvement within the development process any such supplier would be expected to have. These inputs are based upon the questions of:

- Is it necessary to outsource for a given product? This is simply based upon the needs of parts and products – if the organisation cannot develop them without external assistance, the answer is *yes*. If the company can address the problem and develop the product without external assistance then the answer is *no*.
- Does a supplier exist already?
- Does the supplier need to be involved with the development of the product?
- How much supplier time is required to achieve the goals (low/medium/high)?
- What is the perceived supplier interest / commitment level (low/medium/high)?
- What is the perceived supplier capability (low/medium/high)?

Clearly, some responses are straightforward in terms of providing a *yes/no* answer. Others require a perception response of *L/M/H* (low/medium/high) inputs from the user. Such responses are used when a direct *yes/no* answer is not likely to be possible. As an example, when considering the amount of time a supplier may be likely to invest in a new project, it is more beneficial in terms of comparing one supplier against another to identify the potential involvement level rather than simply stating *yes* or *no*. If several suppliers are allocated a *yes* response, it becomes more difficult to compare their suitability for the task.

With this in mind, the model considers these supplier issues from the perspective of *L/M/H* (low/medium/high) inputs from the user (illustrated in Figure 3. 12).

	Supplier									
Product Features	Do we Need to Outsource?	Supplier (If Exists), Do (Does Not exist), Add (Partner Supplier), Do not Know)?	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time/Input Required	Supplier Interest/Commitment Level	Supplier Capability?	Supplier Strength	Attractiveness Of Supplier	TOTAL VALUE
A	y	e	h	h	h	l	h	l	h	122
B	y	k	l	l	h	l	h	h	h	232
C	y	d	l	l	h	l	h	m	m	101

Figure 3. 12 - Example of Repertory Grid Analysis Spreadsheet Model Supplier Rankings (Author)

Utilising a *look-up table* illustrated in Figure 3. 13 (the conversion factors for which are illustrated in Table 3. 9, and the spreadsheet lookup tables in Appendix B, pages 414, 415), the spreadsheet calculates a total value for each factor considered (illustrated in Figure 3. 12).

Lookup Values									
Product Features	**Do we Need to Outsource?**	**Supplier E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)?**	**Supplier Specialist**	**Supplier Involvement in Product Development?**	**Amount of Supplier Time/ Input Required**	**Supplier Interest/ Commitment Level**	**Supplier Capability?**	**Supplier Strength**	**Attractiveness To Supplier**
A	1	3	5	5	1	5	5	1	5
B	1	1	1	1	1	5	5	5	5
C	1	0	1	1	1	5	5	3	3

Figure 3. 13 - Example Repertory Grid Analysis Values from Lookup Table (Author)

Table 3. 9 - Conversion weightings used in Repertory Grid Analysis (Author)

Response Option	Spreadsheet Option Weighting
Y	1
N	0
E	3
P	5
K	3
L	1
M	3
H	5
L (For *Cost* calculations only)	5
M (For *Cost* calculations only)	3
H (For *Cost* calculations only)	1

Having entered the relevant data, the Repertory Grid Analysis model ranks the capability and attractiveness to the organisation of the various features, considers the market desirability score and the importance of the feature dimension from the Conjoint Analysis. It proceeds to consider the perceived supplier interests and capabilities and finally calculates the overall attractiveness to the organisation of pursuing the development of the agile supply chain for the given product features with the suppliers in question (and thereby aligns with the *Four Dimensional Factors of Attractiveness* (Sharifi *et al.,* 2009)). This is illustrated in Figure 3. 14 (the formulae for which are illustrated in Appendix B, page 417). At this juncture, the SME developing its agile supply chain can see the relative importance of the product features in line with the ability of the suggested supply chain to deliver them.

Product Features	Ranking Of Capability/Attractiveness to Company	Market Desirability Score from Conjoint Analysis (Out of 10)	Relative Importance of Feature Dimension from Conjoint Analysis	Supplier Exists), D (Does not Exist), P (Partner	Supplier), ? (Do not know)	Supplier Capability for Project	Supplier Interest/Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY		
A	2	8	52%	3	5	5	5	29			
B	1	4	34%	1	5	5	5	21			
C	3	3	14%	0	5	5	3	19			

Figure 3. 14 - Example Repertory Grid Analysis Calculation Rankings in Spreadsheet Model (Author)

3.7. Accompanying Roadmap Tool

Having considered the PFS, Conjoint Analysis and Repertory Grid Analysis models, it is necessary to consider the proactive implementation of these tools to bring about agile supply chains into SMEs (Ismail *et al,* 2011). Agility implementation methodologies were discussed in the literature review, and whilst enactment approaches exist, they are not generally deemed to be suitable for use in SMEs.

Whilst not the fundamental aim of the research, a suggested process for agile supply chain implementation within SMEs is being proposed herein via a series of roadmaps, thus addressing the challenge highlighted by Sharifi and Zhang (2000), Vázquez-Bustelo *et al.*, (2007) and Zhang (2011) facing the final stage of the agility development process and enabling an SME to move towards achieving its goals. Roadmaps illustrate the path required to reach a destination via activities and links devised through interrogation of experts and roadmap users (Lee *et al*., 2012) whilst utilising recognition, appraisal and substitute options (Kostoff and Schaller, 2001).

The schematic options available for roadmap development include SSADM (Structured Systems Analysis and Design Methodology), SADT (Structured Analysis and Design Technique), GRAI (Groupe de Recherche en Automisation Itegrere) and IDEF (Integration Definition for Function). SADT was formalized into IDEF standards (Presley and Liles, 2015) to provide an ordered configuration of the events taking place, utilising inputs, outputs, implementation tools and the means of control with which to communicate the required actions.

It is believed that IDEF is the most suitable option to consider for roadmap development in this thesis as it illustrates information flows, organisational controls and practical workflows (Softech, 1981) and has been tested for such within SMEs (Presley and Liles, 2015). It is also easy to interpret, making use of graphical arrangements and descriptive overviews (Wilson *et al.,* 2001) to follow a formalised methodology, enabling information to be presented in a controlled way between broad details at the higher levels, down to more specific details at the lower levels of the diagrammatic structures that will allow for future changes to be initiated should they be required.

IDEF0 makes use of boxes to represent activities and arrows that link the activities together via interfaces that are (Akasah *et al.,* 2010):

- *Input* – any aspect of the model that needs to be processed to give an output.
- *Output* – the outcome of an activity
- *Control* – a circumstance or state that controls an activity
- *Mechanism* – the tool needed to change an input to an output within an activity

This is illustrated in Figure 3. 15:

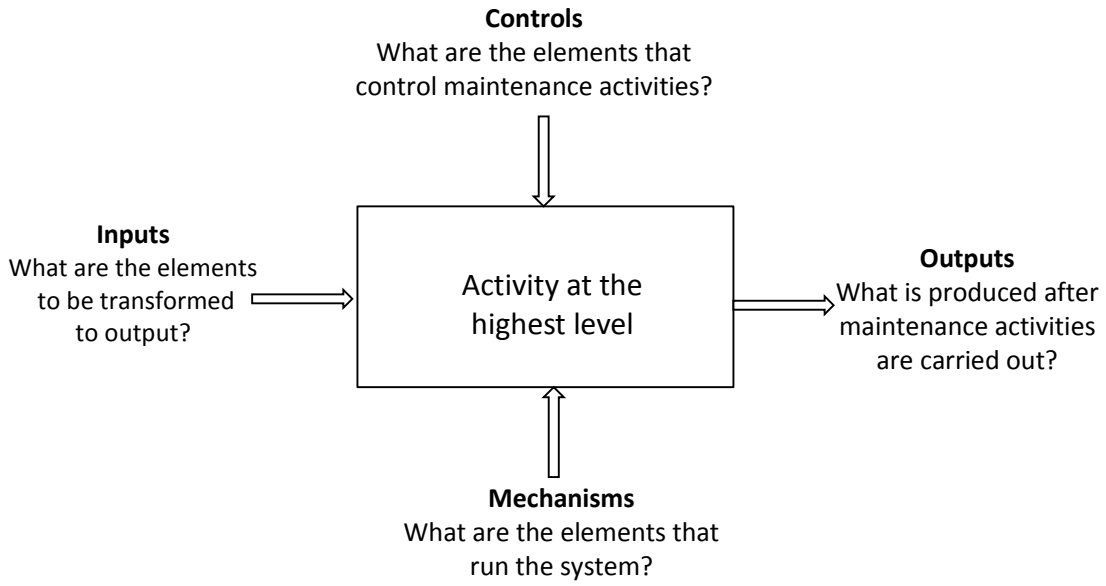


Figure 3. 15 – Basic IDEF0 Model (adapted from Laguna and Marklund, 2013, pp. 138)

An IDEF0 model consists of three key activities, illustrated in Figure 3. 16 (Akasah *et al.,* 2010).

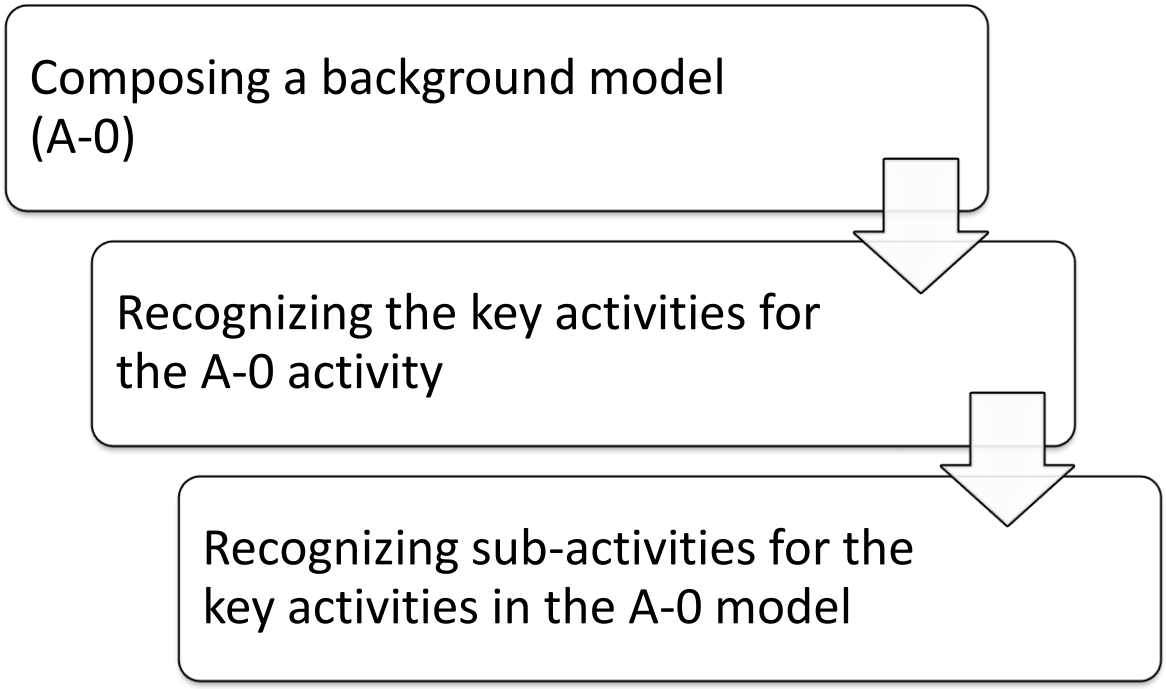


Figure 3. 16 – IDEF0 Key Activities (adapted from Akasah et al., 2010, pp. 5)

The roadmaps presented herein provide an overview schematic for SME organisations to follow to implement agility into their supply chains. SMEs may require further detail and support to make them bespoke for their own needs, but the format presented has been developed to make them generic and simple to use (a point supported by case study examples), and any subsequently required details could be incorporated into the model with little training required on behalf of the SMEs in question. A suitable model for this research utilising this format is presented in the roadmap chapter.

3.8. Framework Model Limitations

As with all models, the framework contains flaws but this does not invalidate it. Box and Draper (1986) highlighted that all models *are wrong* in as much as they are imperfect and cannot replicate life and every eventuality. In this instance it is because the model will never be in a position to interact with all the information available – some of it provided by the organisations under review could be inaccurate, some could be contradictory and some could be imperfect.

The study highlighted that the model is limited by the accuracy of the input data. Whilst not formally part of the structured data collection process (and thereby not used), prior to the start of each interview, brief discussions were held that set the scene in terms of the nature and purpose of the research process and for the interviewees to explain a little about their company background. These discussions raised points of interest, most of which were later formally covered in the questionnaire-interview, but necessarily all. A potential data accuracy issue was therefore highlighted during these discussions.

As an example, at Organisation A, the initial discussion suggested that the company was not operating strategically and was effectively *surviving* on a year-by-year basis, very much responding to its business environment and essentially being held to ransom by other organisations within the supply chain. Whilst the majority of this information was highlighted during the questionnaire-interview, certain formal answers appeared to contradict points made earlier. Detailed consideration of the transcribed interview suggests that whilst the answers formally provided and entered into the PFS Model were accurate at the time that answer was given, there was some discussion and debate between the interviewees prior to agreeing on an answer, requiring subsequent clarification prior to use in the model. With this type of situation in mind it is reasonable to consider the views of Thacker *et al.,* (2004) who suggested that accuracy of the data input into a model is of great importance. Such a situation does not invalidate the model though – it merely suggests that the higher the degree of accuracy of the data entered, the more accurate the outcomes.

Had the informal discussion been part of the data gathering process, this data would have acted as a point of data triangulation, effectively providing a crosscheck of the data from both the perspectives of the initial impression and the data gathered itself. Consequently, not including the initial discussion into the data gathering process could be seen to be a model limitation. It was not incorporated into future questionnaire-interview research due to the informal nature of the process and the inconsistencies it would bring about between different organisational results.

It is worth noting that despite any seeming discrepancies that might have arisen from *inaccurate* data coming from interview subjects, the PFS Model continued to highlight valuable outputs that could be acted upon. The provision of incorrect or imperfect information was highlighted within the *PFS Scores* due to the weightings built into the model itself - the model tends to highlight inconsistencies in the data provided through cross-weighting the data. If an organisation broadly disagrees with its PFS Score in a key area, this will be due to a difference in self-perception and the answers provided via the questionnaire.

Whilst it would be ideal if some means of contingency could be incorporated into the PFS Model such that inaccurate data could be highlighted, this is simply not possible. Every organisation that makes use of the PFS Model does so of their own volition and accordingly it is reasonable to expect a high degree of accuracy in terms of the data presented and entered into the model itself – particularly as the data being entered into the model is coming from senior managers who are in the position to provide it. Failure to deliver relevant and accurate data will not result in realistically usable outputs. To ensure data integrity following the questionnaire-interviews, outlines of the data collected were sent to the organisations under investigation to confirm their accuracy prior to use in the PFS Model.

Another point of significance here relates again to the individuals answering the questions. Whilst their answers can be deemed to be honest and accurate, it was felt there was a *naivety factor* that impacted upon the resultant outputs. Such naivety factors are an aspect of the process that have to be acknowledged and accepted and accordingly the *PFS* model cannot take these into account. These points do not suggest a flaw or criticism of the model itself, but rather a flaw in the human interpretation and understanding of events and activities. The reality of the matter is that it is impossible to escape such factors in their entirety.

From a more generalised perspective, as there is no definitive global definition of SMEs (Kumar and Sosnoski, 2011; Robu, 2013), and as definitions change over time (Kumar and Sosnoski, 2011), SMEs within the UK cannot be considered to be the same as those in other countries (such as the USA). As this research has been conducted exclusively in the UK, the results are not therefore generalizable in other countries.

3.9. Summary

This chapter has considered the background to the conceptual framework, the concepts and theories behind the model and the development of the model itself into which data can be input further to the data gathering process. An overview of the workings of the spreadsheet model has also been presented to illustrate the practical elements of the framework. Furthermore, illustrative outputs from the model have been elucidated and discussed along with consideration of limitations existing within the model as a whole.

In simplistic and concluding form, the conceptual model considered in this chapter has considered the following:

- Diagnosis of the Present Functioning State of an organisation with regards its supply chain such that having identified areas of relative strength and weakness, a series of roadmaps can subsequently be followed to develop agile supply chains.
- Improvement in products through analysis of the most appropriate features required via Conjoint Analysis.
- Alignment of the organisation with suppliers and potential new suppliers within an agile supply chain via Repertory Grid Analysis.

4.0 Methodology

This chapter presents an overview of the research method and design of this thesis. To begin the chapter the research objectives are re-stated, following which a justification for the adopted research approach is presented in line with the philosophical conventions followed as well as an overview of the selection of research participants. The chapter provides an outline of the data collection and analysis processes as well as the approach taken to data gathering and validation, concluding with a discussion of the ethical issues and challenges faced throughout the research process.

4.1. Research Objectives

The key objectives of the research as discussed in the Introduction chapter are:

- **Objective 1 -** To theoretically and empirically explore the idea of agile supply chains in the context of SMEs. This will involve the exploration and extension of agile supply chain frameworks for SMEs, to examine their benefits or otherwise, and to ultimately test this through case studies.
- **Objective 2 -** To develop an integrated framework for agility and agile supply chains such that a methodology can be devised to assist SMEs in adopting agile supply chain approaches. This will be tested empirically through the use of case studies, which in turn will show how the offered model may assist strategic decision-making in SMEs. This strategic decision framework theoretically integrates three key dimensions including the firm, its supply chain and the products being innovated and developed.
- **Objective 3 -** To utilise and develop supporting tools to assist the strategic decision framework (simplified for use by SMEs). These will include qualitative tools and an approach to assist SMEs via a roadmap model.

The core investigative model has been designed around the practical implications for devising and implementing agile supply chains in SMEs. This has been achieved through building a framework (the PFS Model) utilising existing agile supply chain theories and concepts to identify the operating state an SME finds itself in with regards its supply chain agility. The proposed model, once examined, empirically provides the means to devise a support tool and a guide to support SMEs in setting up supply chains and product strategies. A proposed support tool will be depicted in a roadmap model that will be introduced

using data from the field research stage.

To support and substantiate the model, a mixed methodological approach has been adopted, to gather both qualitative and quantitative data at SME case study organisations through the use of a questionnaire-interview. This approach has been selected to gather hard, statistical data for use in the framework model and to then support it with background information about the case study organisations, to observe similarities and differences and provide conclusions to contribute to knowledge. The discovery and subsequent evaluation of this data falls in line with Hair *et al.,* (2007), yet the resultant outputs do not provide absolutes (Gummesson, 2000) - something that is arguably not possible due to the concluding generalisations coming from the case studies.

4.2. Research Methodology

4.2.1. Philosophical Approach

Research epistemology is the method adopted to acquire knowledge. Guba and Lincoln (1994) advocate it to be the consideration of the set of expectations between the association of the *knower* and the *known* and Easterby-Smith *et al.,* (2003) consider it to be the conventions held when questioning the world environment. Howitt (2010) contends epistemology to be the study of knowledge, how individuals *know*, and the corroboration of knowledge and its value.

From an epistemological standpoint, this research interacts with knowledge and the individuals holding it, yet there are two main philosophical approaches that can be taken within management research to ascertain such knowledge: deductive and inductive. Deductive reasoning is attributed to the testing of a hypothesis - having begun the research process with a hypothesis, the researcher gathers specific data to confirm or otherwise the theory under consideration (Creswell and Plano Clark, 2007). Inductive reasoning begins from the other end of the spectrum, with the researcher making observations and gathering data, subsequently identifying patterns to devise a hypothesis from which conclusions can be drawn (Creswell and Plano Clark, 2007).

The research conducted herein is deductive (in line with Creswell and Plano Clark, 2007 and Saunders *et al*., 2012), as its point of initiation is to consider and use the background literature and theories of the subject to develop a practical model for SMEs to introduce agility into their supply chains. Subsequently,

the research process enables the suggested model to be designed and developed and consequently tested at a number of case study SME organisations.

4.2.2. Research Philosophy

The overall research philosophy or adopted paradigm illustrates the ways in which a researcher views the world and is concerned with the type of data and its development required from a study, the way it is gathered, interpreted and designed. There are effectively two streams of approach to consider here – contextual and scientific. The Aristotelian (contextual) perspective believes that individual observations and experiences should be considered within the research as they add depth to the outcomes (Lomas, 2010) and incorporate subjectivist, interpretivist, qualitative and constructionist views. Accordingly, qualitative research is undertaken to recognise the settings in which occurrences take place and hold meaning, relative to the wider contextual setting (Denzin and Lincoln, 2005). Lewin (1952) suggested interviews as a key means of qualitative data gathering, and researchers such as Kvale and Brinkman (2009) have highlighted that the information gained from such opportunities is broad, incorporating narrative, context and language. This results in the researcher interpreting and to some extent making sense of opinions put forward by subjects (Saunders *et al.,* 2012).

By comparison the scientific perspective represents a Platonic world-view (Lomas, 2010) advocating there to be absolute truths that can be found about a given situation and incorporates positivist, objectivist, foundationalist, quantitative and empiricist views. Such quantitative research is interested in discovering certainties based upon findings that are repeatable, impartial, universal and useful for future forecasts (Lincoln and Guba, 1985) and tends to introduce more statistically driven data into the methodology, eliminating to a certain extent at least the direct interaction and interview-based results that come about from qualitative research. Such data usually begins in primitive formats and requires conversion into more usable forms (such as graphs) for trends and relationships to be derived from it (Saunders *et al.,* 2012). Whilst it can be criticised for the lack of contextualisation taking place within the research (Miller *et al.,* 2004), the scientific approach is the most common in business and management research due to its neutral stance (Gummesson, 2000).

A third option, mixed research methodology, is a dual-strategy approach that ordinarily brings together both qualitative and quantitative data (Niglas, 2004; Creswell and Plano Clark, 2007). McQueen and Knussen (2002) argued it to be necessary to incorporate the statistical (quantitative) consideration as well as the human responses (qualitative) to develop an understanding of the issues associated with the

dynamic nature of agile supply chains. As the data collected will consist of both qualitative and quantitative outputs, this study will adopt a mixed methodological approach.

The quantitative data for this study was acquired through the use of a questionnaire-interview where specific answers (some on a *yes/no*, others on a linear scale ranking basis) were required from which there was no alternative, thus deriving statistical information. In line with Creswell (2009), the qualitative data for this study was acquired from various sources within each organisational setting via the questionnaire-interviews, allowing the participants to provide their own rounded answers on focused topics.

Extending the research philosophy, Hall (2012) advocates there to be three approaches that can be taken: the a-paradigmatic approach (suggesting paradigmatic arguments should be ignored), the multiple paradigm approach (suggesting different paradigms can be used in the same study without ensuing incompatibilities) and the single paradigm approach (suggesting both qualitative and quantitative research can take place within a single paradigm). The single paradigm approach allows for both pragmatic and transformative approaches to research (Hall, 2012). Pragmatism (Feilzer, 2010) is predominantly interested in resolving real world problems, whereas the transformative approach is predominantly interested in life experience (Teddlie and Tashakkori, 2009). Hall (2012) identified weaknesses to these approaches and suggested the standpoint of realism. The realist paradigm is not limited to single areas of research and thus enables a broad range of subjects to be considered. Whilst being supported by the positivist approach, such research can flexibly move beyond the normal perspective of positivism and make use of both qualitative and quantitative methods of research (Hall, 2012).

Due to the nature and broad spectrum of the research undertaken for this thesis, this research is being conducted from the viewpoint of the realist paradigm, supported by the positivist perspective, utilising a case study based strategy to provide both qualitative and quantitative data. The methodological choice is that of a planned mixed method, in line with Niglas (2004) and Creswell and Plano Clark (2007).

4.3. Research Strategy, Process and Planning

A research plan and strategy is necessary to identify the path the research will follow. Saunders and Thornhill (2003) suggest that a research strategy is the plan that enables researchers to answer research questions, making use of experiments, surveys, case studies, ethnography, action research, grounded theory, exploratory studies and cross-sectional studies from which to gather data.

The research process adopted for the entire thesis is illustrated in Figure 4. 1.

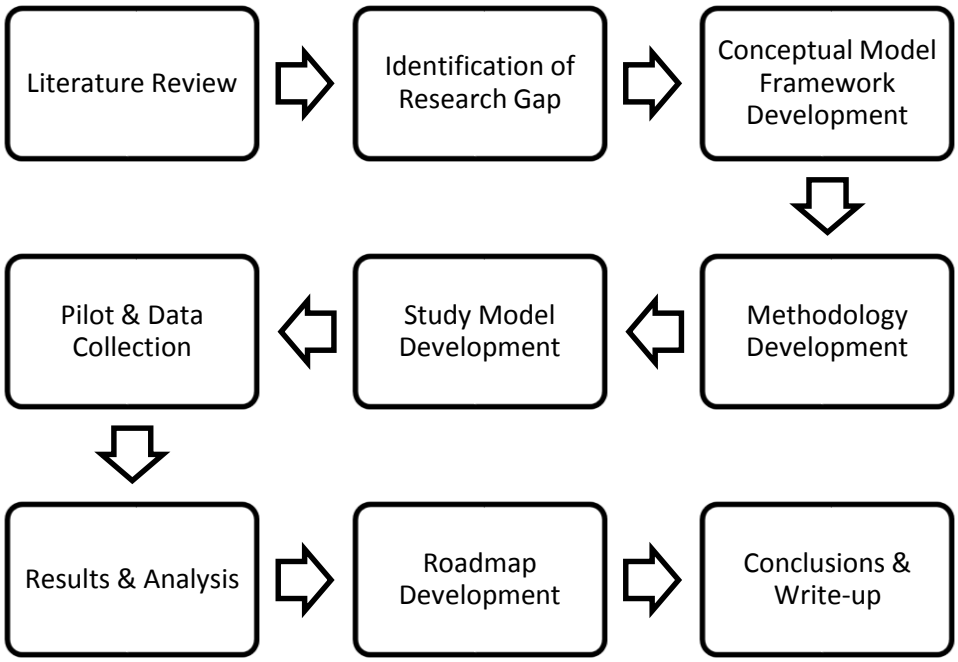


Figure 4. 1 - Overview of the Research Process Adopted for this Thesis (Author)

The point of initiation for the research strategy adopted herein comes from Yin (2013) who argued that case studies ought to be the primary method used to undertake detailed investigations. The rationale for data collection and analysis through case study is not new, and has been utilised in the Operations Management field for some time (McCutcheon and Meredith, 1993; Meredith, 1998; Voss *et al.,* 2002; Eisenhardt and Graebner, 2007). Specifically within the Operations Management field, Voss *et al.,* (2002) and Yin (2013) suggest that case study research is necessary as quantitative findings and theories based upon case studies have to be grounded within qualitative understandings of them. The use of case studies in Operations Management broadly aligns to Yin (2013) who suggests a case study:

- Investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when:
    - The boundaries between phenomenon and context may not be clearly evident
    - It copes with the technically distinctive situation in which there will be many more variables of interest than data points
    - It relies on multiple sources of evidence, with data needing to converge in a triangulating fashion
    - It benefits from the prior development of theoretical propositions to guide data collection and analysis

(Yin, 2013, pp. 16)

However, developing and testing a theory requires a suitable method of research tested against one or more cases and backed up with observed evidence (Eisenhardt, 1989). As this research is based upon theory building and testing, it is reasonable to adopt the approach of using a number of case study subjects to help prove the points under consideration. Benbasat *et al*., (1987) suggested this to be advantageous when the ultimate goal of the research is *description, theory building* or *theory testing*. Similarly, Eisenhardt (1989) viewed case study research from multiple sources in a positive light to garner evidence to support (or otherwise) theories. Eisenhardt and Graebner (2007) also highlight that multiple cases allow for wider examination of the topic.

The research strategy adopted for this thesis is therefore that of multiple case studies (as opposed to a single case study) in line with the points made by Yin (2013) due to the number of organisations that will need to participate to gather sufficient evidence from which to draw conclusions. This is logical as they highlight the different aspects of the organisations under investigation (Yin, 2013) and can incorporate the complex nature of the subject area and the complexities relating to the organisations.

Accordingly, the broad research plan for this thesis was considered in line with the five-stage process highlighted by Stewart *et al.,* (2002), illustrated in Figure 4. 2

Figure 4. 2 – The Five Stage Research Process Model (Stewart et al., 2002, pp. 420)

4.4. Data Collection and Sample Identification

Having acknowledged that both qualitative and quantitative data will be collected via a questionnaire-interview through case study methodology, the data gathering process begins with the identification of a populace, following which either a random or rationalised sample is selected from it to gain sufficient information to test the model under consideration (Hair *et al.,* 2007).

For the data gathering process utilised herein, sample sizes are historically small and there is little formal guidance as to the anticipated sample size to be used. Whilst there are discussions from Guest *et al.,* (2006) and Creswell (2009) relating to the number of organisations that should be approached, there is also a degree of disparity resulting in further questions. Creswell (2009) suggested that a sample size of between 5 and 30 interviews should be conducted for PhD data collection. Guest *et al.,* (2006) indicated that six interviews might be a suitable sample size (provided the sample is relatively homogenous). Other factors do however have to be taken into consideration here including the nature of the research being undertaken, the time allocated for the research and institutional demands (Guest *et al.,* 2006). A balance is therefore required between adequacy and saturation – a point considered by Seidman (2006) who argued for continuing with data collection until little more is being discovered further to what is already known or understood.

Yin (2013) suggested that having acknowledged that several case studies are to be considered, there are two lines that can be taken – the first is to find case study subjects from whom it can be predicted the results will be similar. The other is to select case study subjects that can be predicted to provide dissimilar outcomes. For the research conducted for this thesis the case study subjects selected were likely to neither agree nor conflict *per se*, but in the data gathering process it was envisioned that *similar* data types would be discovered, thus generating a body of information that would be able to prove or

disprove the validity of the model being developed. Having made these points, no matter what the goals or outcomes, it was clear that any organisation partaking in the research would need to be appropriate to the study (an argument supported by Eisenhardt, 1989).

Given the nature of SMEs, the low number of employees that might exist within the organisations and who are expected to partake in this research process, it was decided that sixteen interviews would be conducted at eleven organisations. Whenever possible two interviews were conducted at each organisation to obtain the personal views of the owner or senior manager and crosscheck this against the views of a second interviewee, thus allowing for additionally checking (Seidman, 2006).

Given that this research is based upon agile supply chain development within SMEs, the organisations approached to act as case studies needed to meet the following criterion:

- Meet conditions for SME status
- Be members of a supply chain
- Have a need to or hope to improve efficiency and subsequent operating developments through improvements in their supply chain
- Be open to product development or product alteration – in line with Brown and Eisenhardt (1995) who advocate organisations that are:
    - Planning improved products for attractive markets
    - Capable of developing the said products
    - Working with management support
- Be willing to participate in the investigation and analysis in line with this particular research

An overview of the organisations approached, the number of questionnaires conducted, interviewee roles and turnover in each organisation is presented in Table 4. 1. Detailed consideration is presented in the Findings chapter.

Table 4. 1 – Data Relating to Organisations Approached for Data Gathering (Author)

Organisation Reference Name	Access Dates	Number of Questionnaire-Interviews Conducted	Interviewee Role / Level	Approximate Number of Customers	Number of Suppliers	Number of Products Sold	Annual Turnover £	Follow-up Discussions?	Number of Employees	Sector	B2B / B2C
Organisation A	4/6/13	2	Owner Owner	500	50+	8	£100,000	Yes	7	Manufacture	B2C
Organisation B	16/7/13 27/8/13	2	Operations Manager Manager	140,000	5	12,500	£13 million	Yes	30	Service / Manufacture	B2C
Organisation C	18/7/13 21/9/13	2	Owner Owner	Unknown	4	35	Not disclosed	Yes	15	Service	B2C
Organisation D	10/9/13	Withdrew	Manager	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Organisation E	27/9/13	1	Director Manager	170	4	300	£2 million	Yes	70	Manufacture	B2C
Organisation F	29/11/13 13/12/13	2	Operations Manager Manager	25	100	50 key	£45 million	Yes	250	Manufacture	B2B
Organisation G	16/3/15 19/10/15	1	Owner	300	15	11	£150,000	Yes	5	Service	B2C
Organisation H	12/11/15	2	Director Manager	1900	150	500	£1.6 million	Yes	65	Manufacture	B2B
Organisation I	29/2/16	Withdrew	Manager	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Organisation J	2/3/16	Withdrew	Manager	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Organisation K	7/3/16 14/3/16	1	Owner	100s	5	5	<£100,000	Yes	3	Manufacture	B2C
Organisation L	8/3/16 15/3/16	1	Owner	100s	8	30	<£100,000	Yes	3	Manufacture	B2C
Organisation M	10/3/16	Withdrew	Owner	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Organisation N	10/3/16 17/3/16	1	Owner	1000s	3	10+	<£250,000	Yes	5	Service / Manufacture	B2C
Organisation O	4/4/16 6/4/16	1	Owner	50,000	12	4	£900,000	Yes	12	Manufacture	B2B/B2C

4.5. Questionnaire Design

The questionnaire was designed around the themes identified and considered in the literature review chapter. The units of analysis were considered in the theoretical framework chapter. The questions in the questionnaire-interview were intended to:

- Identify the present state of the organisation in terms of the identifiable supply chain needs that could be acted upon to improve the overall organisational performance.
- Identify product component features required by customers and end users.
- Identify the level of organisational capability in product development or in continuing to produce a product whilst at the same time identifying supplier organisations that the parent organisation could work with and would be interested in being a member of the said supply chain.

The questionnaire design was considered in line with Yin (2013) relating to the practical application of the research and how this thesis has been affected by it. The questions are set out in a questionnaire-interview designed to gather data appertaining to relevant areas of agile supply chains within SME organisations. The majority of questions are closed questions that are specific and require the interviewee to select one from a number of potential answers (for example A, B or C).

Whilst this research requires specific (quantitative data), there is potentially further information (qualitative data) available that could be of use. Accordingly, for every question asked, the interviewee could expand upon it, the information being collected at the same time as the questionnaire data. The specific (quantitative) answers to the questionnaire were noted on the questionnaire form. The expanded (qualitative) answers were digitally recorded for later transcription and analysis. The questionnaire is presented in Appendix A and covers a total of eight areas that will be considered in turn in the Data Analysis chapter that are:

1. Market risk
2. Suppliers and the supply chain
3. Relationship with suppliers
4. Suppliers and the future
5. Vulnerabilities
6. Business Environment
7. Product
8. Financial Situation

To ensure the questionnaire design was effective, Yin (2013) also argued for knowledge of the resource availability for the duration of the study. There were few resource requirements beyond access to SME organisations for data collection, the use of computers and appropriate software.

Finally here, Yin (2013) presented concern over the amount of control that could be exercised by researchers. For this thesis the researcher held control over the questions asked in the questionnaire-interview, which was needed to ensure the gathering of relevant data. The same questions were asked to each organisation visited such that the data should be unbiased in terms of their opportunities to respond and answer.

In principle, it might have been possible for the researcher to select SME organisations to take part in the study to provide data in line with expectations or requirements. It must be clearly stated and recognised that this procedure was not followed and that the only practical requirement of organisations taking part in the study was for them to meet the criterion stated previously. This can be evidenced by the fact that all interviews were recorded and transcribed, enabling subsequent analysis of the data. This also allows for any external quality checks should they ever be deemed necessary. Accordingly, the researcher remained impartial throughout the questionnaire-interview data gathering process and exercised no control over the data outputs given by the participating organisations.

Being aware that all models have potential limitations, the questionnaire-interview was written and subsequently crosschecked by both supervisors and other colleagues. It was then piloted at *Organisation A*. As it was being used for the first time it took approximately 30% longer to run through than in subsequent organisations. Minor changes were made following this experience, but the amendments were purely based upon minimal alterations to wording within the questions, making them easier to answer (Illustrated in Table 4. 2). Having made alterations, the questions were asked again and the subsequent data acquired (and agreed by the company). Through this method, the data obtained from all organisations was via identical questions. Accordingly all organisations were treated equally with the same survey tool.

Table 4. 2 – Alterations to Questions following pilot at Organisation A (Author)

Questionnaire Section	Original Question	Updated Question
Part 3: Suppliers and Supply Chain	What paybacks result from supplier design and production?	To date, do you benefit from organisations within the main capabilities in the design and production process?
Part 3: Suppliers and Supply Chain	Could your supply chain create product development?	Do you believe the supply chain as a whole (with all inter-related knowledge) could act as a vehicle for the future development and sales for your products?
Part 5: The Environment	Are low borrowing rates monitored?	Does the organisation monitor financial institutions for the lowest borrowing rates?
Part 5: The Environment	Are payment deferrals experienced?	Does the organisation deal with delayed payments post sales?
Part 6: The Product	Customer requirements	The product emerged as a direct reactionary result of a customers' requirement
Part 6: The Product	We develop customer based products	We are currently pursuing development of the product for our existing customers (product development)

4.6. Data Analysis

Having gathered information relating to SME organisational processes and behaviours regarding agile supply chains, the said data must be analysed. Data analysis is primarily concerned with arranging and classifying the data gathered during the research process, the foundations of which have historically been statistically driven (Miller *et al.*, 2004). By comparison, qualitative data analysis is deemed to be subjective rather than absolute due to the human interpretations of the information (Robson, 2002). In line with Kvale and Brinkmann (2009), the initiating points for this research were its intention and substance. Consequently, the foundations for the data analysis are driven by the content of the data obtained which is in both quantitative and qualitative forms.

There are five key frameworks around which data analysis is centred which are:

- Hermeneutic analysis, which interprets the straightforward answers provided by respondents instead of contextualising the responses and the ways in which answers are provided (May, 2001).
- Discourse analysis considers which the language used by respondents (Creswell, 2009).
- Content analysis, which categorises qualitative data responses, effectively evaluating the information from a quantitative perspective (Myers, 2009).
- Grounded theory allows for theories to be created through interactions between data analysis and collection (Eriksson and Kovalainen, 2008).
- Thematic analysis, which is similar to grounded theory as it allows for categorisation within given codes. The difference between these concepts is that under thematic analysis the codes are labelled and organised at the same time (Boyatzis, 1998), allowing for themes to emerge from the resultant data set.

Given that the purpose of the questionnaire-interview was to identify the processes and behaviours existing in SMEs, content analysis emerges as the most appropriate approach to adopt. To achieve this, all answers were noted on the questionnaire-interview forms and subsequently entered into the PFS Model. All questionnaire-interviews were recorded, and each recording was transcribed, thus enabling data checks and for the analysis of any further and subsequent discussions that took place throughout the process.

4.7. Data Validation

Validity, rigour and reliability are important aspects of the data collection process. Data validity considers the integrity and trustworthiness of the data outputs relative to the goals against which the research has been set (Collis and Hussey, 2003). Rather than simply being an aspect of the research design, Schofield (2002) argued that the interviewees and research practices influence data validity. It is important to note that the data collected through the questionnaire-interview approach was proffered from an independent standpoint (on behalf of the interviewee and not the interviewer). In order to maximise the benefits from the model under consideration, it is reasonable to suggest that accurate information being entered into the model will produce accurate results. Should an interviewee provide inaccurate data, the model will still provide results, but they will be less accurate and therefore less beneficial to the organisation in the long term. Logically therefore, the argument can be proffered for the partaking organisations to provide accurate information, eliminating personal feelings or inclinations.

To ensure data validity and eliminate the possibility of researcher bias, efforts were made to eradicate any influences the researcher might impose upon those providing data. Subsequently, the researcher specifically followed the questions as outlined within the questionnaire at each organisation visited. All detailed discussion points made by interviewees were recorded and transcribed. This primarily ensured an accurate record of the data was held for reference purposes (thus avoiding the potential for inferences and meaning to be lost when later interpreting the data). From a secondary perspective this ensured the integrity of the data – in the unlikely event that any data could be brought into question, the original recordings and subsequent transcriptions could be presented so as to negate any possible suggestion of data tampering.

To some extent it is impossible to eliminate all influences due to the fact that any data derived from the research process must be interpreted. It can be argued that the methods of recording the collected facts improved the validity of the data as it ensured the researcher collected data appropriately and did not make interpretations due to the overseeing eye of the research supervisor. In terms of researcher bias, it is worth noting that the various different means of data gathering will, to a large extent, have eliminated the possibilities of bias due to the cross-over in the data gathering methodologies – any bias in one form of analysis would be highlighted by another, thus effectively eliminating potential impartiality.

Such validity-based arguments are founded upon internal factors (Maxwell, 2002). As data was collected from a number of case study organisations for this thesis, an element of external validity comes into being such that comparisons between organisations can be made (Schofield, 2002). Whilst external validity (or generalisability) is of no personal interest between the organisations associated with this research in terms of their similarities and differences, the overall research outcome would ideally be in a position to validate the PFS Model in generalisability terms and its use within organisations such that it can be proven to be effective.

Further to validity, rigour is concerned with the checks used to ensure the data outcomes are reliable and valid. For this research, as the questions asked required interviewee interpretation, the lack of hard and fast data could prove to be problematic in terms of reliability and so in line with Kvale and Brinkmann (2009), reliability is seen to exist in terms of consistency and dependability of the research outputs. Whenever possible more than one person was interviewed in each organisation. Furthermore, in each case the respondents were contacted after the interviews to check on certain points and to gather any feedback following the process. This triangulation improved the reliability of the data findings in line with Gray (2009).

Reliability is concerned with the uniformity of results. Due to possible interviewee interpretation of questions and subsequent answers emanating from the questionnaire-interview, such uniformity can be difficult to assure such that Kvale and Brinkmann (2009) argued that reliability can be considered to be the uniformity or consistency of the research outcomes. The model developed in

the study is clearly designed to highlight negative issues that come about through different actions of partaking organisations to highlight areas for improvement. Pragmatically, there could be some concern here with regards issues such as differing business cycles – depending upon the time of the business cycles and when the research has taken place during the year, different results may have come about. With this and reliability in mind, the questionnaires and interviews used were intended to be considered from a *macro* perspective and not related to a specific time of year, thus providing consistent and reliable results throughout the dataset.

Should inaccurate data be presented by one of the case study organisations (or indeed any other organisation in the future wishing to utilise the model), this does not invalidate the models. The data obtained during the research provides a basis from which the models can be tested – provided the model outcomes fall in line with expectations relative to the data entered then the models themselves can be deemed to be effective.

All participating organisations were provided with the research outputs to ensure the data was reliably and accurately presented. All feedback was positive and no organisation suggested any concern with regards data reliability.

4.8. Research Limitations and Challenges

This study utilises case study research which has been criticised and scrutinised (Yin, 2013) for a potential lack of enquiry (interestingly, Eisenhardt and Graebner (2007) emphasise the point that case studies allow researchers to observe situations in real-world situations – quite dissimilar from isolated laboratory experiments), any misunderstandings that could come about due to links that may exist with cases used for teaching, the time and volume of data created and required for analysis (indicated by Feagin *et al.,* 1991), and finally the comparative advantage the methodology has by comparison with other research methods.

When considering these themes it is necessary to contemplate counter arguments put forward such as the viewpoint made by Gummesson (1988) who advocated the legitimacy of a "limited number of observations" in research and also Eisenhardt (1989) who argued that case studies only require the use of one or more cases to provide a theoretical output. Eisenhardt (1989) also advocated the point that every case study acts as a unique investigation – the outputs of which are diagnostic units in their own right. Any further cases used to replicate or test a situation simply expand the theory under consideration further (Yin, 2013). Morgeson & Hofmann (1999) advocate that many processes performed across different disciplines are similar to one another – thus case study research will have similarities to other types of research in spite of the different subject areas under

consideration. It is also important to consider the point specifically relating to case study research made by Gioia *et al*., (2012) who advocate that it is possible to not only make use of case study samples of one but to also make generalisations based upon those said case studies. This argument is in line with the point made by Corley and Gioia (2011) who suggest that theories should postulate an overview of a subject from the perspective of a generalised point of view. Gioia *et al*., (2012) suggest that research data emanating from individual cases ought to be relevant enough to make them appropriate to other areas of research.

With these points in mind, and given the fact that eleven organisations (enabling sixteen interviews) took part in the case study research, the level of enquiry was deemed to be of a suitable depth and held a positively research-based approach (as opposed to data gathering for teaching purposes). Whilst a good deal of both qualitative and quantitative data was collated, quantitative data has been collected under a clearly defined target with the explicit need to populate a specifically designed spreadsheet model.

From a macro perspective, an on-going concern comes from the point that research in general can be guilty of lacking rigour. In this instance, rigour relates to ensuring the research methodology backs the problem being considered in order to gain valid scientific results (Straub, 1991). The potential warning for the researcher here is that he or she becomes too involved with the subject and the concerns surrounding it, instead of concentrating on the scientific rigour with which the research is actually being based (Rapoport, 1970). It could however be argued at the same time that a researcher could be too goal orientated and completely ignore the concern of the subjects – possibly failing to meet ethical standards.

In this instance, the research methodology was selected as it was felt it supported the problem under consideration and would accordingly produce valid results. The researcher has no intended goal-outcomes other than to develop a model and subsequent roadmap pathways with which to assist SMEs in developing agile supply chains in the future. No attempts have been made throughout the entire research methodology to steer the process in any way such that particular outcomes would come about.

The previously mentioned point relating to the gathering of consulting or teaching data should be considered at this point. Gummesson (1999) considered the role of the researcher acting as a consultant rather than a researcher:

1. Research requires extra and more detailed documentary evidence than consultancy for it to be academically credible.
2. Researchers need to justify their work through validated theories whereas consultants simply look for numerical justification.

3. Consultants tend to operate under budgetary and fiscal constraints that are not necessarily a factor that a researcher faces.

With regards these points and the research conducted for this thesis, the following points can be made:

1. The research has been completed via the compilation of detailed documentary evidence (answers from both questionnaire-interviews have been documented, alongside which the interviews were recorded and transcribed for further analysis of the responses given).
2. The work is being considered in line with validated theories and concepts.
3. There were no budgetary or fiscal constraints involved with this study. Organisations and their employees partaking in the research process did so voluntarily and had the option to withdraw from the procedure at any given time with the guarantee of the destruction of their data findings. This last point illustrates the research operating in line with the ethical policies and protocols of The University of Liverpool.
4. The research has been conducted in a linear way only in as much as it was a process – each organisation was visited in turn and the data collation concluded before the next organisation was visited. The data derived from the research was deemed to be *psychical* or *subconscious* (Gummesson, 1999) in as much as the answers given by respondents were very much immediate – they were not deliberated upon over a period of time or allowed any time for detailed analysis prior to the response.

At the outset of the research, every effort was made to ensure the questionnaire-interview and interviews were structured. Due to the nature of interviews, an element of pragmatism must come about from the point of view of the research questions - some of the areas discussed by the interviewee were extended beyond the structured questions that were initially written, as interviewees were allowed to *open up* about the topics in question and consider them from broader perspectives. Consequently, in practice, whilst the questions asked were *structured*, the questionnaire-interview process allowed for elements of the questions to be treated in a *semi-structured* format by the interviewee.

The results of this particular study therefore come about as a mixture of both hard data and human views, considered individually and in conjunction with each other to develop a more fully rounded understanding of the situation such that a roadmap of theoretical and practical relevance could be developed. It is difficult to argue for the use of other research methods in order to garner both hard and broad evidence on the subject under consideration.

A challenge experienced during the research undertaking relates to Mumford's (2001) point as to the researcher *getting in, staying in and getting out* of the organisation in order for the research to be conducted. The challenges faced in this study were merely due to the nature of the business the organisations operated in and the times their representatives were available for interview and data gathering missions.

To some extent along the same lines, there was a concern as to how the relationship between the researcher and the client organisations would impact on the outcomes – would it create tensions (the possibility of which was suggested by Sheehan, 1986) or improve the relationship between those parties involved (advocated by Reason and Rowan, 1981)? Efforts were made by the researcher to remain detached from the organisations involved and to concentrate solely on gathering evidence for the purpose of the study. At no point in the process has there been any indication of tensions or relationship difficulties. From the perspective of this study, the researcher was totally impartial from the outset of the task.

4.9. Ethics and Dissemination

The ethical processes involved in research are of paramount importance to ensure all participants are protected during the research process (Saunders *et al*., 2012). From both an ethical and pragmatic perspective, as highlighted by Benbasat *et al*., (1987), in the process of selecting and approaching organisations to partake in the study it was important to ensure that the companies and their employees would not be harmed as a result of the research. At the same time it was necessary to warrant that suitable answers (and therefore relevant data) would be offered by the said employees so as to make the data relevant for use in the analysis.

As all research had to be conducted in SMEs and as the individuals interviewed needed to be either owners or managers to meet ethical guidelines, careful participant selection had to take place. Suitable participants had to be in a position to make judgments (Hair *et al.,* 2007) and be in a position to fully answer the questions relative to the experiences of the organisation. Subsequently, all participants were found via a network of colleagues and contacts, a process considered by Eriksson and Kovalainen (2008). They were either telephoned or emailed with an explanation as to the nature of enquiry and a request to meet at some point in future. Once this initial point of contact had been made, participants assisted by introducing other suitable candidates who could take part in the research (such an escalation was also considered by Eriksson and Kovalainen, 2008).

Whilst there was no contract signed between the organisations and the researcher as suggested ought to be in place by Mumford (2001) and seconded by O'Brien (2001), this was not deemed a requirement of the work due to the relationship between The University of Liverpool's Agility Centre and the organisations involved in the study. However, in line with The University of Liverpool's ethical procedures, an ethical declaration and research agreement was signed by the researcher and every member of each organisation that had any input into the research process, clearly explaining the nature of the processes in question, the nature of the research, the obligations of all parties concerned and their rights. Furthermore, from the outset, a theoretical problem statement was presented to the organisations and individuals partaking in the research to ensure that the research and the premise upon which it is based is valid.

As the research was organisationally based (and accordingly personal information relating to individuals was not required) and in line with guidelines and procedures, ethical clearance was given for the research to proceed by The University of Liverpool. Ethical issues that affected this research included:

- Gaining access to organisations to take part in the research.
- Gaining access to individuals willing to partake in the research within the said organisations.
- Explaining informed consent, anonymity and confidentiality and ensuring every participant signed a clearance form acknowledging their participation in the research. As the interviewees were all either senior managers or owner-managers, any potential ethical risks for any other employee providing information for this research was eliminated.
- Providing participants with an overview of the research, a preview of the questionnaire-interview along with an explanation of the usage of the data gathered.
- Providing participants with an explanation with regards to withdrawing from the process – should they at any point wish to withdraw they were free to do so, and any data gathered would be immediately destroyed.
- Ensuring participants were aware of the independence of the study.

No issues relating to confidentiality or anonymity were experienced during the research for this thesis. Personal information was not required and was not discussed, and no company was aware of any other participating organisation. Whilst every interviewee had the right to withdraw from the process, only four did. In each instance, the reasoning was purely business-based and not related to the line of questioning involved.

The interviews were conducted by the interviewer reading out the questions, following which the interviewee was allowed to provide answers. The responses were recorded in an unbiased manner and every point made was later transcribed to ensure the completeness of the data reported and to ensure the findings were appropriately represented. Following the interviews all interviewees were

emailed and thanked for their participation and resultant research outputs were forwarded to them for consideration. All participants that completed the interview process responded positively.

Organisational anonymity was ensured by coding each organisation (Organisation A for example) relative to the order in which the research was conducted. Individual anonymity was ensured by subsequent coding (Interviewee X for example). Access to audio recordings required a pass code on the Dictaphone used, and all transcribed information was securely stored in locked data files. Access to this data has been exclusively restricted to the author via electronic passwords on a password-secured computer. In line with ethical guidelines, the research data will be destroyed following the end of the thesis process.

Having considered the research methodology, the next area for consideration are the data findings.

5.0 Findings

At this stage in the thesis a research gap has been identified along with suggested tools to bridge it, and as recognised in the methodology chapter, data has been collected via questionnaire-interviews at case study SME organisations to test the said bridging tools. In this chapter, findings from each organisation are presented in turn, followed by aggregated findings that will be discussed in the following chapter.

Whilst some organisations were booked to partake in the study, they withdrew. These companies are acknowledged in Table 4. 1, page 109 in the Methodology chapter but are not considered here. Each case study considered individually will consist of:

- Company overview
- Presentation of qualitative PFS Model results
- Presentation of quantitative PFS Model results following approximately 440 pages of interview transcription
- Presentation of Conjoint Analysis results
- Presentation of Repertory Grid Analysis results

5.1. Case Study Organisation A

- **Company overview**

Organisation A is a privately owned and operated SME, manufacturing equipment for the international beauty-cosmetics industry. The business predominantly manufactures a key range of products, modifying and customising them to meet client needs.

Trade is predominantly UK based, but the organisation also services international markets. Despite this the organisation is experiencing expansion challenges, and acknowledges the nature of the product and the size of the organisation to be realistic barriers in the immediate future. The company relocated to its present premises approximately one year prior to the research being undertaken to benefit from transportation networks, to expand their own business network, for proximity to customers and clients, to improve business-to-business contacts and to learn from other organisations and build on their experiences.

- **Market risk**

Organisation A designs all products in-house, dividing its product lines into the *professional therapy* and the *education* markets. The *education* market is targeted for two key reasons – to sell products to trainers and colleges (to make sales and raise revenue), and to develop working relationships with students who could start their own businesses in the future and purchase products. Working to this strategy, the organisation runs workshops for trainers and students alike in support of their products and for the long-term security of the business. The organisation's R&D is run by one of the owner-managers who designs new and improves older products when warranted by market demand.

Organisation A has ten key competitors locally and approximately 500 customers. The customer base has grown by approximately 10% over the last year, due in part to the company developing into new markets (including the Far East) with relaxed attitudes to healthcare and also through improving its online presence. Whilst online sales are growing annually, maintaining the customer base is becoming increasingly difficult. New products are periodically introduced to attract new and old customers and old products receive line extensions, but the company has to work hard to maintain relationships with long-term customers. The organisation believes it can expand further and sees markets of opportunity in the Far East and the Netherlands over the next few years, with sales coming from internet or direct forms of contact with clients. Whilst the organisation is trying to expand its online presence to improve marketing, it has not aligned this with its supply chain or utilised any statistical information derived therein.

The organisation has no liabilities to banks or other financial institutions and makes minimal use of free credit from suppliers, yet sees finance as the main obstacle to growth. This is primarily due to the relatively small turnover, the risks associated with borrowing capital to fund expansion and the organisation's ability to repay the debts.

- **Suppliers and the supply chain**

The supply chain is large for a company with such a small turnover with component parts being sourced from fifty suppliers. Orders are made as and when components are required due to the costs involved. Subsequently, component and finished good stocks are held at minimum levels, resulting in the organisation adopting a JIT philosophy. The organisation felt an MRP based system of stock control might be more effective, but costs are prohibitive.

The supply chain is relatively complex and largely under the control of the suppliers, evidenced by the long lead times experienced in obtaining parts, resulting in customers having to be made aware of the specialist nature of the products and the subsequent anticipated waiting time for the delivery of their goods. The organisation is not concerned with such delivery times, believing customers are willing to wait for the right goods based on the quality of the products themselves and the

relationship built up between the parties. A subsequent benefit of this is that having purchased a product, replacement parts can only be purchased from *Organisation A* as alternatives do not exist, resulting in clients having no alternative but to wait until the components are available.

- **Relationship with suppliers**

The organisation is part of a supply chain, sharing prices and component specifications rather than detailed market and business data. Non-disclosure agreements support this, and relationships within the supply chain as a whole are poor and cooperation lacking. Correspondingly there is little support for supply chain-wide product development as a result. Such factors negatively impact lead times – the company's awareness of which drives manufacturing schedules.

However, despite this and whilst acknowledging there to be no benefits from working closely with all suppliers, the organisation has developed relationships with a select number of suppliers providing a two-way flow of information and positive benefits in terms of design, production, research (for materials used), quality, delivery, cost reduction, efficiency and profitability.

- **Suppliers and the future**

The company believes the supplier relationships it has developed are sufficiently robust in principle to technically develop total process integration, yet acknowledges challenges in doing so. These relationships are effectively based upon factors such as ensuring quality needs and delivery times are met. Subsequently, some suppliers consider *Organisation A* to be simply purchasing parts. Despite knowledge of the end products and their nature, these suppliers show no interest in what the parts are for, thus effectively ruling out long-term relationship opportunities, and creating challenges for agile supply chain development.

- **Vulnerabilities**

The company is vulnerable in terms of the delays associated with receiving parts from suppliers. Some response contradictions arose here with the acknowledgement of an eight to twelve week delay in component delivery for many items. Elsewhere in the organisation, it was acknowledged for the delay to be "probably 14 days at the longest." Consequently the company has to work around such delivery delays, leaving it vulnerable to customers making purchases from competitors. To help overcome this situation, should a customer require a part at short notice and *Organisation A* itself does not hold one in stock, one will be removed from a completed product and shipped. Pragmatically, the company argues this to be the only option available to minimise customer losses and negative publicity. Yet they also highlight the added costs in terms of labour and the potential

for damaging finished products, as well as rendering the completed product unsellable until the replacement parts arrive – thus affecting cash flow.

The rationale for the long delivery lead times is that due to the economic climate, all suppliers have reduced stocks internationally and produce as and when required, only ordering their own raw materials at the point of order from *Organisation A*. The world economy is therefore a potentially significant area of vulnerability for the company.

- **Business Environment**

The company provided little knowledge or application of issues relating to the business environment, acknowledging it does little in terms of monitoring the environment relative to its business position. It was suggested that whilst the company is aware of key economic indicators such as inflation, such knowledge is not utilised. The company is cautious about change and uncertainty, and largely reacts to its business situation. This, alongside the uncertainty provided by the supply chain situation is reflected in its strategic goal of "staying in business."

- **Product**

Market research performed by one of the company owners largely determines both product design and the product portfolio. The exact format of the research was not established but was broadly understood to be via social media and discussions with clients and students.

All products the company manufactures are expensive, with starting prices of several thousand pounds. Clients therefore expect them to have a long working life, the consequence of which being the substantial time delay between purchases and subsequent repeat purchases. Due to the specialist nature of the products being sold and the fact that the products are advertised as being of high quality and reliability, the opportunities to build obsolescence into them are limited. Furthermore, as many of the products built require professional training for safe use, the organisation is clearly aware of legalities relating to the merchandise it develops.

The organisation discussed the possibility of selling sundry products (such as creams and rejuvenating moisturisers) as a means of developing an on-going income stream aside from its present sales lines, but dismissed the idea as not being an area for serious development.

- **Financial Situation**

It is understood that the organisation is effectively debt-free and has no intention of placing itself in any future debt. Furthermore, the organisation appears to be financially and economically self-aware, thus in principle at least being in a position to navigate itself through economic territories. At the same time however, it was made clear that the organisation's goal was to just survive the following financial year. There was little evidence of new markets being formally developed by the organisation and little more than a *survival* outlook being the *modus operandi*. These two perspectives could be seen to be working counter to one another – a factor supported by the PFS score.

- **Summary Table**

A summary table of findings for Organisation A is presented in Table 5. 1.

Table 5. 1 – Summary of Organisation A Findings (Author)

Organisation A Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	10
Product Complexity (Low/Medium/High)	High
Number of Suppliers	50+
Number of Customers	500
Number of Products Sold	8
Annual Turnover	£100,000
Growth Rate for Previous 12 months	10%
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	Low
Level of Uncertainty and change faced within Business Environment (Low/Medium/High)	High

- **PFS Model results**

The PFS Model results for *Organisation A* are illustrated in Figure 5. 1 and Table 5. 2.

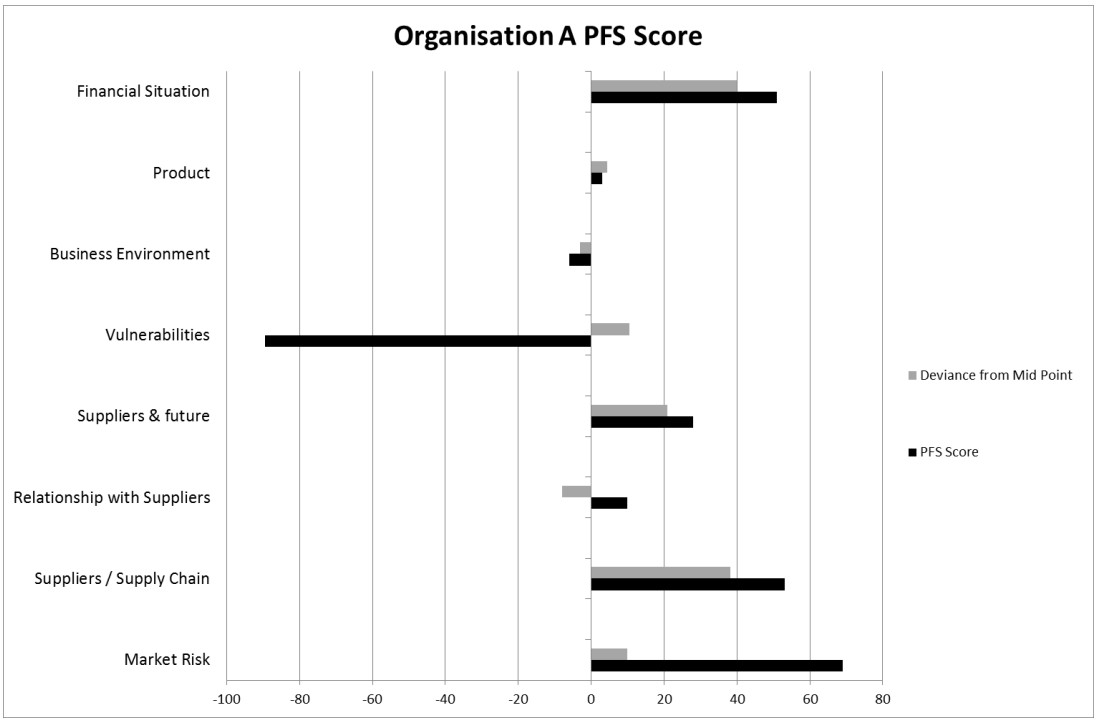


Figure 5. 1 - Organisation A PFS Model Score (Author)

Table 5. 2 – Organisation A PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation A PFS SCORE	POTENTIAL SPREAD			Organisation A % DEVIANCE from MID Point	Organisation A DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	69	7	59	111	117%	10
Suppliers / Supply Chain	53.1	-18	15	48	354%	38.1
Relationship with Suppliers	10	-14	18	50	56%	-8
Suppliers & future	28	-106	7	120	400%	21
Vulnerabilities	-89.5	-215	-100	15	90%	10.5
Business Environment	-6	-18	-3	12	200%	-3
Product	3	-120	-1.5	117	-200%	4.5
Financial Situation	51	-31	11	53	464%	40

The most significant results indicate the vulnerability of the company and its lack of environmental and economic awareness – outputs that are supported by comments and statements made during interviews with the owners. The positive outputs relating to suppliers and market risk are also clearly evident and supported during the interviews.

- **Conjoint analysis results**

Organisation A was not in a position to provide data for a Conjoint Analysis.

- **Repertory grid analysis results**

Organisation A was not in a position to provide data for a Repertory Grid Analysis.

5.2. Case Study Organisation B

- **Company overview**

Organisation B is an SME operating within the niche market of hobby modelling, remaining in the ownership of the same family since its establishment over seventy years ago. A professional management team has overseen substantial growth, significantly expanding the number of products available for sale and establishing a strong internet presence. Stock control is managed by a real-time computer system and up-to-the-minute statistics are projected in real-time to all staff, indicating data including live website hits and sales relative to target. Products are packaged and dispatched from a separate warehouse.

The organisation has an annual turnover of approximately £13 million, with a profit target of 10% of turnover in a diminishing market worth approximately £60 million annually. It predominantly serves mid-generation and older male customers, and is presently trying to open itself up to younger clients. Whilst competitor organisations have suffered due to economic constraints and the dwindling market, this organisation has grown, predominantly due to its online presence and magazine advertisements that direct potential customers to make purchases at an effective website.

The organisation has almost exclusively relied upon manufacturers producing goods for customers to purchase. The organisation is looking at the supply chain as a whole to expand its market. It is also developing its own lines of products – some of which are available and winning awards.

- **Market Risk**

Organisation B believes describes itself as the *Amazon* of its market and is keen to adopt new marketing techniques as well as work with suppliers to expand its market. It is less interested in the supply chain elements of growth, believing it important to maintain its supply chain through Chinese links.

The company is concerned with the lack of competition in the marketplace. This is based upon the number of sellers in the retail market rather than the products manufacturers make. Whilst this could be seen to be advantageous to *Organisation B,* it believes the opposite to be the case – competition encourages new customers, and poor competition lowers perceptions for all involved.

- **Suppliers and the Supply Chain**

The organisation has historically aggressively made use of its size in the market to take advantage of suppliers. However, suppliers do not perceive it to be so dominant within the market to be of major significance, and are no longer willing to assist in terms of discounts - such practices being more likely to be levied on smaller competitors.

Due to the internet and methods of communication therein, the organisation is experiencing less interaction with supplier representatives than it has done in the past, thereby largely eliminating the supply chain relationships that have existed historically. The result is the need for an improved IT platform to maintain supply chain communications. Due to admitted organisational complacency, external experts have had to be employed to develop such a platform.

This electronic means of communication works within the organisation's needs – particularly as it is reluctant to interact directly with suppliers. One example highlights the fact that the organisation tries never to make complaints to suppliers, knowing that its many competitors do on a regular basis. The rationale for this being that by placing annual orders in the region of £8 million with one particular supplier, they receive preferential treatment by not causing any difficulties or troubles. A manager estimated that in the process of spending £8 million annually with this one supplier they possibly make telephone contact 40 times a year – a far smaller ratio than competitors who seemingly make a complaint on average for every £1000 spent. This lack of interaction with the supply chain is being used as a means of developing stronger links within the supply chain itself – thus improving its reputation for working with suppliers such that suppliers will ultimately want to work more closely with the company in the future.

Due to the electronic nature of the market, the majority of *Organisation B's* supply chain interaction with regards sharing market information comes in electronic format – the usability of which alters depending upon the supplier. Having discussed the opportunities that might exist should there be a development of the free-flow of information between key players in the supply chain (thus

developing agility) to improve marketing effectiveness, *Organisation B* does not believe that such information flows would be of benefit. This contradicts the basic premise of agile supply chains – an issue that should be of interest to *Organisation B*. It might subsequently back-up the point made previously regarding *Organisation B's* wish to pursue more marketing-based options rather than supply chain goals.

The organisation believes it would have benefitted from developing a supply chain in line with its own needs, and would ideally have set up its own manufacturing unit as well, highlighting its vulnerability to suppliers under two key points:

1. Chinese companies manufacture the majority of products, and the growing economic power of the Chinese economy and the corresponding power of individual manufacturers has resulted in the manufacturers becoming too powerful. Subsequently, *Organisation B* is reliant upon their willingness to supply as and when needed. Previous experiences from manufacturers refusing to ship goods to order have resulted in UK wholesale distributors being left in a stranglehold position.

2. The industry brand names are changing their business models to overcome this situation, with some now supplying directly to the buying public, thus potentially eliminating the retail role of *Organisation B* and its competitors in the marketplace. Whilst this potentially creates the competition that the company wants, it does so whilst changing the entire nature of the industry, effectively removing *Organisation B* and its competitors.

Whilst these points are of concern, *Organisation B* highlights the learning curve and potentially high costs associated with such changes for wholesalers. Developing the knowledge and infrastructure to sell directly to the public is time consuming and expensive and factors that the wholesalers would have to undertake. *Organisation B* is therefore actively involved in dissuading supplier organisations from making such decisions and challenging the present state of the supply chain.

Another area of concern for the sector as a whole comes from the fact that out of around 600 accounts across the UK held by one supplier, *Organisation B* accounts for approximately 20% worth of the supplier's annual turnover. Suppliers are keen to nurture new entrants into the market and support them to mitigate any potential losses should *Organisation B* (or any other large retailer) be made bankrupt and cease to operate (as happened recently to a key competitor). In the past, suppliers were willing to allow *Organisation B* to purchase all old stock and buy in bulk to enable savings to be made. This has now been stopped and such sales of old stock are spread out amongst all competitors in the field.

Organisation B is aware of advances in 3-D printing both from the perspective of their suppliers and within the organisation itself. There is a view to installing a 3-D printer within the retail premises to produce components for customers on a JIT-type basis. The organisation acknowledges that such a move is unlikely to benefit relationships within the supply chain as it is becoming a more direct competitor with its suppliers.

- **Relationship with Suppliers**

Organisation B has active relationships with companies capable of producing new and improved products, but acknowledges that information does not flow transparently between itself and other organisations and that process integration could take place more effectively. However, at this point in time it is not believed there to be a great incentive to develop process integration between the different organisations involved because it is not understood how such changes could be made. Furthermore, whilst considering supply chain issues such as postponement and supplier fill rates, it was revealed that such practices are unlikely to take place within the industry as most products are batch manufactured.

Furthermore, the operations manager highlighted that the supply chain as a whole is inefficient and has been designed around the needs of the suppliers and not the retailers – the customers being simply expected to wait. The company acknowledges that a supplier entering the market placing customer experience as the key priority could change the nature of the market forever.

The organisation discussed the introduction of supplier service level agreements, but argued that due to the monopolistic power of the suppliers and the nature of the market, should *Organisation B* force the issue and enforce such agreements, suppliers would simply increase the delivery time of the service level agreement to ensure they always meet the requirements. As only between 20% and 30% of supplies arrive on time, this would create further challenges for the company.

- **Suppliers and the Future**

The potential for manufacturers selling directly to the marketplace and its potential for the future was discussed earlier in this section.

Along a similar argument, the company is in the process of manufacturing and expanding its own line of products, employing perceived cheaper Chinese manufacturers. Delivery is at the behest of the manufacturer which is clearly problematic as success is dependent upon the manufacturer supplying goods in line with expectations. Failure to meet such requirements renders *Organisation B* impotent, with the only option being to change supplier - a time consuming and costly exercise, but one that could hold long-term benefits.

- **Vulnerabilities**

The company considers itself to be relatively vulnerable with regards its supply chain and the potential for suppliers bypassing the organisation and selling directly to the public. The organisation believes that given its poor supplier relationships, there is a need to develop relationships within the supply chain.

Whilst being the largest organisation in its field, *Organisation B* is very much aware of the highly competitive nature of the market. Smaller organisations are of most concern as they receive promotional deals from suppliers and can undercut *Organisation B* in the market. Due to the relationship *Organisation B* has with its suppliers, the company is unlikely to receive preferential treatment based on the volume of sales it makes, and contrary to expectation is in some ways viewed negatively by suppliers (due to past interactions), thus highlighting a vulnerability.

The organisation is also vulnerable from manufacturers being unwilling to maintain high levels of output, to the extent that they are eliminating warehouse stocks until demand is such to continue manufacturing again in case market behaviour changes.

- **Business Environment**

Taking into account economic factors such as interest and exchange rates, *Organisation B* believes there to be potential for new component manufacturers to be sourced, removing its reliance on Chinese producers. It is believed that by switching to UK-based manufacturers, it would provide new collaborative opportunities and the development of its own agile supply chain to provide a more stable long-term situation. Furthermore, by marketing the products as designed and manufactured in the UK, the product and *Organisation B's* profiles would be raised, leveraging more sales and the possibility of economies of scale advantages.

- **Product**

Many of the products sold by the organisation are modelled around historical artefacts and once a customer owns a version, second purchases are highly unlikely. Consequently, suppliers manufacture products in batches to reduce storage and over-production. Manufacturers are aware that product development relative to the historical timeline is running short as there are fewer artefacts to reproduce that have not been sold before. Consequently, manufacturers are delaying the introduction of new products to extend the overall product life cycles. *Organisation B* argues that this strategy benefits itself as well as the manufacturers.

Facing increased competition and dwindling product releases, the organisation has experimented with its own manufacture of high quality products. After prolonged testing and marketing, the

products have proved to be successful and have won a number of national and international awards. The company is considering the production of its own model scales and variations of models already on the market to capitalise on such successes, potentially taking it into new international markets altogether. The lead times for such product releases are potentially four years, making the organisation consider manufacturing and supply chain partners closer to home. This point is under debate though due to the perceived cost savings achieved whilst working with Chinese manufacturers.

Notwithstanding this, such has been the market response that should the organisation advertise the availability of a new product for a given time in the future, they are confident they can sell the merchandise two years before manufacture, thus providing a positive cash flow to develop and manufacture future products. As customers are willing to pay for products so far in advance of delivery and due to the reputation the organisation holds, it has been suggested that any increase in costs resulting from regional or local manufacture could be offset by the market demand for the products being supplied.

- **Financial Situation**

The organisation's financial exposure to suppliers is relatively small (10%), and their exposure to external and economic changes low (5%). The organisation acknowledged that interest rate changes could bring about dramatic alterations in customer spending. Accordingly, the company believes their exposure to the *business-to-consumer* market trend is 15%.

As the organisation is cash-rich it feels under little pressure and consequently spends little time monitoring institutional rates of lending. Whilst the company makes use of supplier interest-free repayment periods, it does not abuse the situation and pays early or on time to maintain good relationships. The company does not believe that costs associated with the inflation of supplies or the cost of living to be of any great significance or vulnerability for the future.

- **Summary Table**

A summary table of findings for Organisation B is presented in Table 5. 3.

Table 5. 3 – Summary of Organisation B Findings (Author)

Organisation B Summary Table	
Level of Competition (Low/Medium/High)	Medium
Number of Key Competitors	20+
Product Complexity (Low/Medium/High)	Medium/High
Number of Suppliers	5
Number of Customers	140,000
Number of Products Sold	12,500
Annual Turnover	£13 million
Sales as a percentage of Market Turnover	21.6%
Financial Liability	Very low
Overall Relationship with Suppliers (Low/Medium/High)	Medium
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model results**

The PFS Model results for *Organisation B* are illustrated in Figure 5. 2 and Table 5. 4.

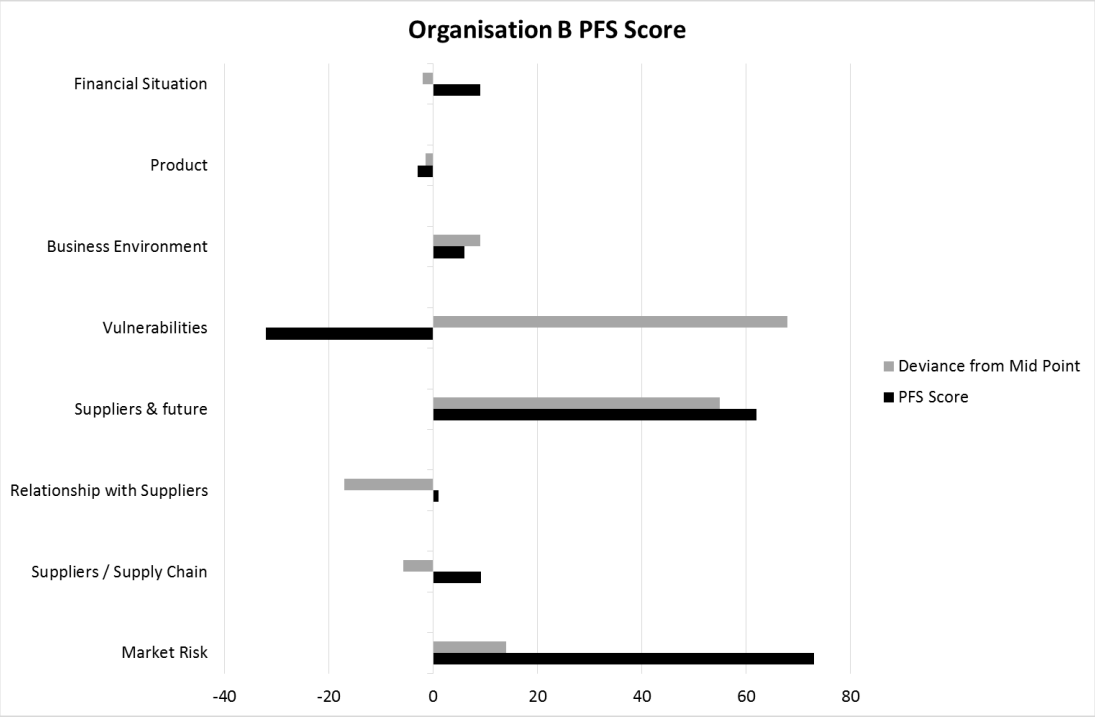


Figure 5. 2 - Organisation B PFS Model Score (Author)

Table 5. 4 - Organisation B PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation B PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	73	7	59	111	124%	14
Suppliers / Supply Chain	9.25	-18	15	48	62%	-5.75
Relationship with Suppliers	1	-14	18	50	6%	-17
Suppliers & future	62	-106	7	120	886%	55
Vulnerabilities	-32	-215	-100	15	32%	68
Business Environment	6	-18	-3	12	-200%	9
Product	-3	-120	-1.5	117	200%	-1.5
Financial Situation	9	-31	11	53	82%	-2

The most significant results indicate issues emanating from the vulnerability of the company and its concerns over product availability. From a positive standpoint, the company is strong in the marketplace and is in a robust position with regards suppliers and the future. Follow up discussions indicated that the PFS Model outputs are supported by comments and statements made by the Operations Manager.

- **Conjoint analysis results**

Organisation B was not in a position to provide data for a Conjoint Analysis.

- **Repertory grid analysis results**

Organisation B was not in a position to provide data for a Repertory Grid Analysis.

5.3. Case Study Organisation C

- **Company overview**

Organisation C is an SME operating a small group of fresh food outlets located in busy areas of a holiday resort, targeting customers that would otherwise opt for fast food outlets, providing more of a fast dining experience with niche dishes. Whilst acknowledging the organisation does not manufacture in the traditional sense, the fact that it produces fresh meals to order results in it being considered in this study and it is argued that the basic concept behind this study is applicable. Furthermore, various elements of agile supply chain concepts are of benefit to the organisation.

The organisation is wholly and privately owned, employing approximately 10 individuals on a full and part-time basis at each of its locations and expressed interest in partaking of this study to potentially work more closely with suppliers to minimise costs, maximise profits and better understand customer requirements.

The company is of interest as whilst it competes to some extent against larger and better-known chains of fast food restaurants in the local area, it is not in itself a fast-food restaurant (its target audience is arguably older with more disposable income) and cannot benefit from economies of scale in terms of purchasing supplies or manufacturing output. It is not in a position to purchase pre-

made parts or components and cannot accurately predict market demand for its services based on previous annual demand within the marketplace in the same way that some of its larger rivals can.

The market for the organisation is broken down into two groupings. The first group is *passing trade* – holiday customers and locals who happen to enter the establishment based upon momentary and impulse needs. Such clients would be unlikely to know of the potential market niche in which the organisation exists prior to entering the premises. The second grouping of customers is what the owners refer to as *regulars*. Regular customers are well aware of the niche food lines produced and are aware of daily specials, planning their visits accordingly. The organisation works hard to ensure customers return to secure the future for the business, but the potential loss of a customer would not make a significant impact to the organisation.

- **Market risk**

The company operates in a local market that is arguably worth tens of millions of pounds annually. Whilst the type of customers attracted are known, it is not possible to decipher the number of customers in the marketplace on an annual basis with any degree of accuracy. Equally so, due to the changing nature of the marketplace and the fickle nature of potential customers, it would be virtually impossible to predict future sales for the organisation or any of its competitors. Whilst some fast-food competitors utilise MRP-based systems in their stock ordering and staff requirements based on daily, weekly, monthly and annual data, the costs of such systems are prohibitively expensive and are out of reach for all but the largest national and internationally based competitors. *Organisation C* is not in a position to invest in such a system.

Due to its location and reputation, the owners state the company's profitability to be in the medium-range, and suggest that any new competitor entering the local market is likely to have low profitability - largely due to market saturation within the local area. Specific data relating to the organisational profitability were not made available – resultantly detailed analysis of the organisation is made with this in mind.

- **Suppliers and the Supply Chain**

The company orders supplies on a daily basis with the expectation that they will be delivered the following day and paid for promptly. Should a supplier fail to provide the raw materials required, another supplier is contacted and the materials sought and through careful management there is little waste.

There is no clear stockholding or ordering system based around any type of analysis or modelling. The system is built on the knowledge of the owner-manager and the chefs, requiring an element of

experiential judgement. Should purchasing decisions be made by another employee, there is no historical data from which to base orders. The informal system presently works but its shortcomings are apparent, and absences by those usually involved results in errors being made.

- **Relationship with Suppliers**

Whilst *Organisation C's* owners would welcome closer working relationships with suppliers, the timely arrival of supplies takes precedence. Improving such relationships would improve the product ranges, reduce lead times and help the organisation grow, yet it was made clear that suppliers have had little interest in helping to develop the product range or help make cost savings, improve quality, delivery, or flexibility for any organisation within the supply chain. Contrary to this point, it emerged that *Organisation C* believes suppliers would respond favourably to closer strategic ties and information sharing as suppliers are unaware of their own or their customer needs and requirements.

Further to this, evidence indicates there is little information flow between *Organisation C* and the rest of the supply chain. There are few supplier face-to-face meetings, and whilst some information is presented to them in electronic format, there is effectively no information sharing throughout the supply chain with regards marketing, market demand, changes in customer tastes or the future. There is also no clear evidence of supplier marketing strategies, despite the fact that this information could benefit both organisations.

- **Suppliers and the Future**

The organisation orders through a number of suppliers on a regular basis, turning to different suppliers at short notice when orders fail to arrive. Such actions negate most adverse impacts on customers, subsequent turnover and profitability. *Organisation C* does not see this changing in the future.

- **Vulnerabilities**

Organisation C is not vulnerable to issues such as strikes or the environment, and is unconcerned with criminal issues or vulnerabilities due to accidents owing to insurance cover. However, there are concerns with regards finding suitable individuals to work for and represent the organisation. Due to the nature of the business and its seven-day operating requirements, employing a suitably flexible workforce is of paramount importance and an on-going challenge.

- **Business Environment**

The organisation believes it has strong working relationships with its suppliers and believes approximately only 2% of purchased items are in any way defective.

The organisation is aware of various barriers that could affect its gross profits. It feels confident in terms of its own leadership ability and flexibility, and has little concern regarding suppliers and the supply chain as a whole as it believes it possible to simply swap suppliers at short notice should it prove to be necessary. However, it is aware of potential barriers in terms of finance, its IT capabilities and the fact that the lack of such systems eliminates the opportunities for it to interact more directly with the supply chain.

- **Product**

Whilst the organisation has its standard menu, it makes allowance for seasonal variations and fluctuations, and accordingly varies the menu to suit market demand and the availability of fresh supplies. Due to the flexibility of the organisation, it takes advantage of fluctuating prices and offers daily specials to customers at short notice.

Due to its flexibility and knowledge of both the supply chain and the products it sells, *Organisation C* has little wastage and manages to minimise the obsolescence time of the raw materials purchased.

- **Financial Situation**

The organisation is not technologically advanced, and whilst it is of little interest, it was acknowledged that a simplistic stock and financial control system might provide greater control of the organisation as a whole as well as assisting in supply chain interactions.

The organisation is aware of its financial situation, interacting with financial institutions to ascertain the lowest rates of borrowing. It is also broadly aware of its operating environment. However, there is little need for the organisation to be aware of factors such as exchange rates or inflation rates. Arguably, should such economic factors become more important to the organisation, any increase in costs that come about from them would be passed on to the end customer.

- **Summary Table**

A summary table of findings for Organisation C is presented in Table 5. 5.

Table 5. 5 – Summary of Organisation C Findings (Author)

Organisation C Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	30+
Product Complexity (Low/Medium/High)	Medium
Number of Suppliers	4
Number of Customers	Unknown
Number of Products Sold	35
Annual Turnover	Not disclosed
Financial Liability	Low
Overall Relationship with Suppliers (Low/Medium/High)	Low
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model results**

The PFS Model results are illustrated in Figure 5. 3 and Table 5. 6.

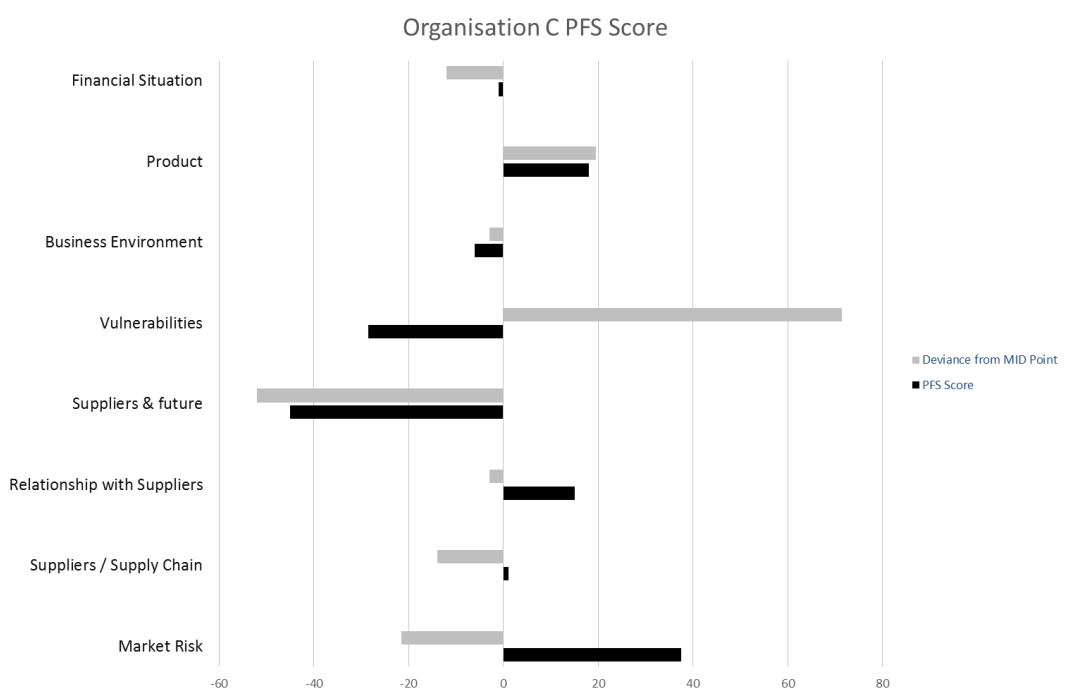


Figure 5. 3 - Organisation C PFS Model Score (Author)

Table 5. 6 - Organisation C PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation C PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	37.5	7	59	111	64%	-21.5
Suppliers / Supply Chain	1.02	-18	15	48	7%	-13.98
Relationship with Supplier	15	-14	18	50	83%	-3
Suppliers & future	-45	-106	7	120	-643%	-52
Vulnerabilities	-28.5	-215	-100	15	29%	71.5
Business Environment	-6	-18	-3	12	200%	-3
Product	18	-120	-1.5	117	-1200%	19.5
Financial Situation	-1	-31	11	53	-9%	-12

There are three key strengths that *Organisation C* possesses as indicated by the PFS data results. The first being the products sold. These are selected by customers on a menu that varies but the organisation maintains core staples that attract returning customers. When questioned about certain elements of this, the organisation is clear that it simply alters its products to meet perceived customer requirements at any given time of the year.

The model indicates positive results regarding suppliers and the relationships therein. This was supported during interviews but the impersonal nature of the relationships was illustrated and questioned with regards improving the supply chain in the long term.

The other strength the organisation maintains is its market risk. It acknowledges that it has local competition, but does maintain a relative niche in the market. The owners question whether this niche would be maintained if the company was sold (inferring that the owners – rather than the organisation as a whole make the market risk a strength).

The remaining areas under consideration produce negative (or close to negative) outcomes in the PFS Model – each of which was substantiated by the owners.

- **Conjoint analysis results**

Organisation C was not in a position to provide data for a Conjoint Analysis.

- **Repertory grid analysis results**

Organisation C was not in a position to provide data for a Repertory Grid Analysis.

5.4. Case Study Organisation E

- **Company overview**

Organisation E is an SME manufacturer selling products within the UK. The company is looking to expand quickly, manufacturing one-off and small batches of products. These products are currently sold in a niche market, but plans exist to adapt them to both the industrial and household markets to assist in company and market growth.

Over the last three years *Organisation E* has had an annual average turnover of around £1 million. The present turnover is £2 million and current predictions suggest an increase to £4 million next year. The manufacturing processes implemented over recent years show efficiency gains due to the flexibility of the workforce who work closely with management to meet organisational goals.

The organisation is in a fortunate position to be established whilst developing a group of products that are now effectively in the introduction stage of a new marketplace. The new product group is essentially being sold as a replacement for older traditional models, but are far more efficient and effective – the key selling point being their delivery of cost savings to users. Such is the potential international market demand for the product being sold that the company has recently been refinanced and there appears to be substantial interest from potential new investors.

The directors of the organisation believe the company might face challenges in the future as it could arguably be held to ransom by suppliers and placed into an effective supply gridlock due to the potential for suppliers challenging the market themselves, manufacturing their own versions of *Organisation E's* products. Furthermore, other organisations could, upon realising the potential, try to gain a foothold in the market and compete.

- **Market risk**

The organisation sees itself in the introductory stage of the product life cycle but acknowledges it would struggle to accurately identify its market for each product.

Whilst the organisation is not aware of any direct competitors, there is a general awareness of international competition for generic products and whilst competitors may not yet be visible, it is envisaged they exist and are gearing themselves up to take advantage of the high international market demand.

The directors state that profitability is not high, but envisage this will change in the next 3 to 5 years, highlighting a recent financial restructure, investor reserves and potential investors as indications of the likely profitability.

- **Suppliers and the Supply Chain**

Possibly the biggest challenge the organisation faces relates to the supply chain. Key international suppliers provide components for manufacture and *Organisation E* is one of a multitude of purchasers. Whilst the international suppliers would not wish to lose *Organisation E* from a purchasing perspective, the directors state they are not inclined to treat the organisation differently from any other customer.

Subsequently, information flows are largely one-way and at the behest of the supplier. The directors feel that information transfer to suppliers is of little interest at the present time. It was acknowledged that this creates certain challenges in terms of improving the agile supply chain as the relationships required necessitate suppliers to change their modus operandi.

Direct competition from key suppliers would be potentially catastrophic as supplier organisations would simply cease trading with *Organisation E*, eliminating its source of components for manufacture and rendering it effectively inoperable, ultimately resulting in bankruptcy.

- **Relationship with Suppliers**

Organisation E is aware of its key suppliers and their supply chain position. It is less interested in purchasing components for the lowest price, being more concerned to create its own market demand. Component failure rates are low, and issues regarding failure are not limited to the same suppliers. Whilst *Organisation E* acknowledges their largest suppliers provide no commitment whatsoever to the organisation, it also acknowledges that local suppliers are willing to provide closer working relationships.

The organisation acknowledges its supply chain has been created in an ad hoc way and due to its small size the company is not a priority for any of its suppliers. Resultantly it is effectively manufacturing on the back of technological growth offered by suppliers – essentially chasing technology rather than designing products with new or future technologies in mind.

The company holds a mixture of supplier contracts – predominantly working with individual orders but also to scheduled orders in some instances. There have been attempts to ensure suppliers hold stock for the organisation in the past but this was not successful. Consequently the organisation sees the development of an agile supply chain and more effective supplier relationships to be the way forward.

Whilst the largest suppliers provide certain amounts of information to *Organisation E*, the company itself does not share any with suppliers. Furthermore areas such as cost transparency, working with other members of the supply chain, working together to develop a new marketplace, developing new product ranges, work to improve quality, delivery, flexibility and design are all areas that could

be worked on by the supply chain as a whole. *Organisation E* acknowledges the benefits that could arise from such supply chain relationships (including lead time reduction and enabling the company to implement the growth strategy more effectively), but does not believe other supply chain members would be interested in developing such links. In terms of its key priorities, *Organisation E* is interested in its proximity to suppliers, costs, quality, and the ability of the supply chain as a whole to deliver in every aspect of the relationship.

- **Suppliers and the Future**

Whilst there are currently four main suppliers providing components to the company, with the exception of components from one supplier, all parts are interchangeable. This allows supply issues to be overcome easily through changing suppliers.

The company is aware that its largest four suppliers are intensely building upcoming and new technologies into their products such that they can be installed into future *Organisation E* products. Other suppliers are less forward thinking.

Some of the larger suppliers are providing information about new technologies for the future. Other suppliers however are disinclined to do so which is a negative point as it is believed this would help improve issues with regards research, quality, delivery, cost reduction, efficiency and profitability.

The company believes it has the ability to electronically communicate with all members of the supply chain to bring about some of the improvements indicated. This has not been considered from a practical point of view though. The present IT systems are rudimentary and out-dated and the facilities to change the company's IT infrastructure do not really exist. Further research suggests the IT facilities perceived to be of importance here are little more than emails and telephone calls, indicating the organisation is possibly not as advanced as it would like to believe in terms of its supply chain communication setup.

The large suppliers are well aware of the broad nature of the market, and operate utilising best practice manufacturing techniques. The smaller suppliers upon which the company depends do not make use of techniques such as lean production or postponement and consequently the organisation has to deal with delays in component delivery.

In an ideal world, *Organisation E* hopes to develop its supply chain through developing its relationships and creating more of an agile set up. Under the *agile* heading it would hope to improve delivery standards, flexibility, its ability to share risk with suppliers, improve cooperation and cost transparency, and improve technical support and technology transfer. General consensus within the organisation is that many of these points would not happen easily at all.

- **Vulnerabilities**

Whilst the organisation believes it to be unlikely, it is possible for component suppliers to start manufacturing their own products to compete directly with those of *Organisation E*. Should this occur, *Organisation E* is clear that Dutch competition would effectively bankrupt the organisation. This explains the organisation's view regarding its relationship with suppliers – it is difficult to build relationships with supplier organisations that could become a competitor. It is also important to note on this particular point, that whilst the organisation is presently expanding, from a worldwide perspective it is arguably not deemed particularly important by its suppliers, as it is simply not large enough. Again, with this point in mind it is therefore somewhat surprising that the organisation considers itself to be in a positive position with regards the market risk.

From an internal perspective, the organisation does not face many issues with regards vulnerability. In its present operating structure it does not face issues with regards management, finance, regulations, change, ICT, cost of labour, employment regulations, transport networks or the availability of suitable skills and qualifications for personnel.

A vulnerability that does exist for the company comes from the fact that the organisation is not visibly aware of the potential obsolescence of all products it is selling, and during the research it became clear that this is not a point that has been considered in the last 12 years of operation. The company is rational about this though as at the moment the organisation is manufacturing cutting-edge products that are arguably unique and bespoke – provided it is operating an effective stock system then the bespoke nature of the products it manufactures would suggest there ought to be little or no obsolescence issues to consider.

The argument with regards obsolescence is of concern though for the company, and is highlighted by the relatively ad hoc bulk ordering systems that exist. Whilst components are not ordered on an ad hoc basis as such, they have historically been over-ordered and any components not immediately used in manufacture have been held as stock. Provided these components are fully utilised in manufacture this is not an issue, and indeed in line with economic batch order quantity purchases, the company does not have a problem. However, the company does not take into account the fact that suppliers introduce new technologies into components approximately 4 times a year and at the point the upgraded components are purchased, older components held in stock are effectively rendered out-dated and are subsequently never used, remaining in stock and losing the company money and occupying storage space.

- **Business Environment**

The organisation is aware of the increased market demand for their generic products due to societal changes and the natural inclination for households and organisations to reduce their overhead costs.

- **Product**

Organisation E manufactures 300 products making use of the latest developments in LED technology. Due to the international economic situations and the ever-increasing drive to utilise less resources, *Organisation E* is placed in an ideal position to capitalise by aligning its energy-efficient products with global market needs. The international demand for LEDs and *Organisation E*'s finished products are unknown, but extremely large. The organisation is aware their products can be adapted to virtually any type of industrial or living situation, and could arguably be developed into portable devices for use in remote areas of the world.

Having made this point, production is dependent upon the supply of LEDs from a limited number of international manufacturers who are willing to supply to anyone requiring them. There is no likelihood of exclusivity deals within the supply chain for such components so *Organisation E* operates at the behest of the supply chain.

- **Financial Situation**

The company is broadly aware of and takes into account economic perspectives as well as the wider business environment in which it operates. The organisation is aware of its financial exposure to banks and investors, as well as its use of credit from suppliers, and ensures its borrowing rates are as low as possible. It makes a point of not exceeding these supplier credit ratings and therefore sees itself as being financially secure. It experiences some delays in payment from customers that correspondingly affect cash flow.

Having discussed the purchasing and stockholding issues within the organisation and the fact that new component parts out-date older parts held in stock several times a year, the organisational approach to inflation was of interest. A company director identified the company takes little interest in inflation, as it is deemed a macro-economic issue and not something the organisation itself can alter. It was pointed out that there are inflationary issues the company could tackle with regards its stock – component upgrades and the subsequent development of unused stock effectively create a micro-economic element of inflation and upgraded components effectively act as a measure of inflation by eliminating value from the older components that can no longer be used. It was accepted by the director that the company could take control of such inflationary issues.

- **Summary Table**

A summary table of findings for Organisation E is presented in Table 5. 7.

Table 5. 7 – Summary of Organisation E Findings (Author)

Organisation E Summary Table	
Level of Competition (Low/Medium/High)	Medium
Number of Key Competitors	Unknown
Product Complexity (Low/Medium/High)	Medium
Number of Suppliers	4
Number of Customers	170
Number of Products Sold	300
Annual Turnover	£2 million
Financial Liability	Unknown but positive
Overall Relationship with Suppliers (Low/Medium/High)	Low
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model results**

The PFS Model results are illustrated in Figure 5. 4 and Table 5. 8.

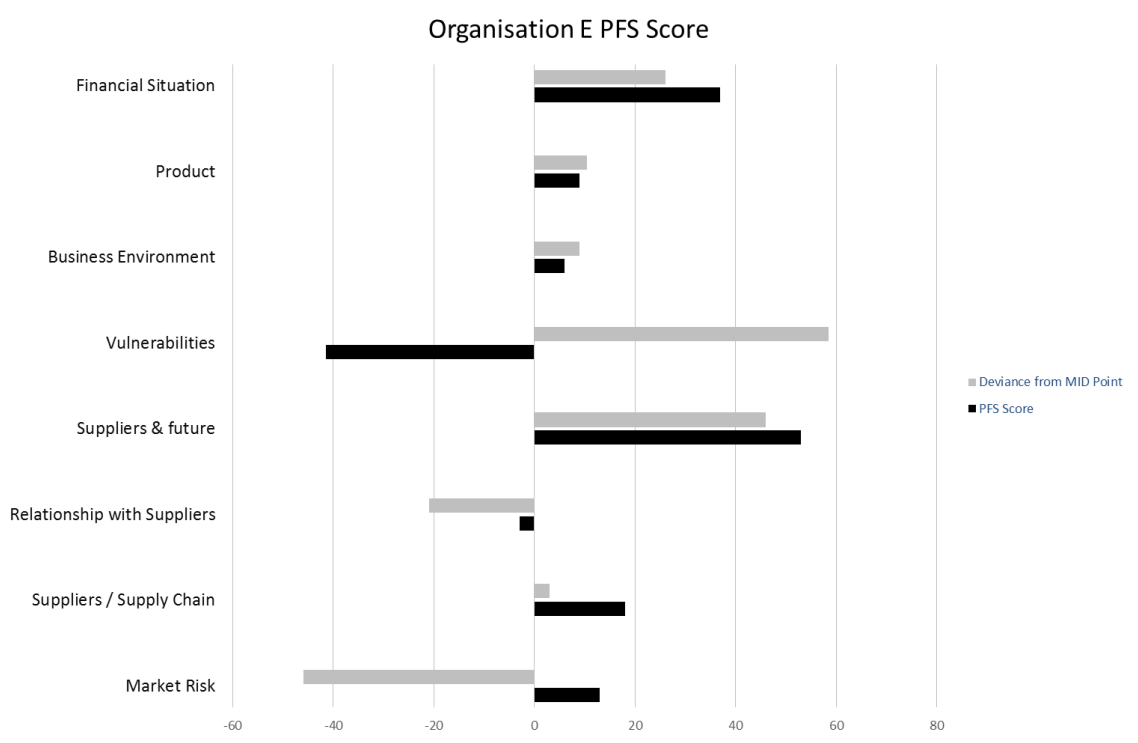


Figure 5. 4 - Organisation E PFS Model Score (Author)

Table 5. 8 - Organisation E PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation E PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	13	7	59	111	22%	-46
Suppliers / Supply Chain	18	-18	15	48	120%	3
Relationship with Suppliers	-3	-14	18	50	-17%	-21
Suppliers & future	53	-106	7	120	757%	46
Vulnerabilities	-41.5	-215	-100	15	42%	58.5
Business Environment	6	-18	-3	12	-200%	9
Product	9	-120	-1.5	117	-600%	10.5
Financial Situation	37	-31	11	53	336%	26

The PFS Model highlights *vulnerabilities* and *relationships with suppliers* as being areas of concern for *Organisation E*. Conversely, all other PFS Model outcomes are highlighted as being positive for the company. These outcomes (and even the potential irregularity with regards the company and its negative *relationship with suppliers* compared to the very positive *future* with its suppliers) are in line with organisational expectations and the PFS Model results have been deemed to illustrate a true picture of the situation for the company.

- **Conjoint analysis results**

Organisation E was not in a position to provide data for a Conjoint Analysis.

- **Repertory grid analysis results**

Organisation E was not in a position to provide data for a Repertory Grid Analysis.

5.5. Case Study Organisation F

- **Company overview**

Organisation F manufactures internationally recognised white goods for the domestic kitchen market and is working towards developing bespoke products to meet individual customer requirements. As most components are nationally or internationally sourced, the company effectively assembles these products.

Whilst the organisation has a long-held traditional market for its goods, it now owns a number of competitor brands, subsequently manufacturing under those brand names (as well as its own original brand name) on a national and international basis. The company supplies a number of key high-street retailers within the UK market and sells goods throughout Europe and China, benefitting from the 'made in the UK' label affixed to each product. This is particularly attractive in the Chinese market.

Whilst *Organisation F* is in a strong position within the UK domestic and European markets, it faces potential future threats. To overcome such potential threats, the organisation is considering developing assembly plants strategically placed throughout Europe to benefit from lower operating costs.

Organisation F is the largest organisation in this study and was able to provide data to consider Conjoint and Repertory Grid Analyses as a means of supporting the PFS Model outputs.

- **Market risk**

Whilst the organisation itself is clearly established, it considers its market presence and risk in line with each of the key products it sells. Accordingly it categorises each product within the various marketing stages of introduction, growth, maturity, and decline. The organisation is aware that when a particular product is reaching maturity, new products are required to take over that element of the market.

The organisation is aware of its own corporate strategy and the markets in which it operates. At the moment these are clearly within the business-to-business segments, but based on the fact that more individualised and bespoke products will be required in the future, it is possible that the organisation will develop its relationships closer within the business-to-consumer segments.

Despite the fact the organisation now owns many of the key brands within its own market, it faces stiff competition from other international brands. It also faces competition as a knock-on effect from high-street retailers, their requirements and the need to work within legal rules and regulations. Further to this, whilst the organisation perpetually considers product development for both new and existing customers, it is aware that it occasionally reacts to competition within the marketplace and at other times takes the lead in this arena.

The nature of the market requires the organisation to be highly competitive from a product, price and timely distribution perspective. Due to the nature of high street and internet sales and the competition brought about by low prices therein, the organisation has had to make certain key operational changes. One example of this comes from different organisations selling the same products the company manufactures. Due to underselling practices and high street chains trying to undercut one another, the nature of the contracts *Organisation F* holds with certain high-street chains means that should a competitor undercut the chain, *Organisation F* is contractually obliged to make up the shortfall. As the company wishes to avoid this (due to the financial instability such practices bring about, as well as the financially-dependent time delays between making a delivery, receiving the income for the goods and then subsequently having to wait in case a repayment becomes necessary), key product lines are sold to retailers with minor modifications. Resultantly, each retailer effectively sells the same, but legally different products thus removing the financial issues associated with the undercut-repayment practices that have been hitherto experienced. This type of strategic decision has resulted in organisational stability.

The organisation is expanding its market to China and is aware that many components used in product manufacture are sourced from Chinese suppliers. Evidently it would not take much for such suppliers to develop their manufacturing and supply chain one step further to include the final assembly processes in their home country. Consequently, the organisation is looking to potentially move manufacture elsewhere – potential locations include central Europe.

At the same time the company is pursuing market opportunities by personalising products for customers, effectively manufacturing product features to individual requirements. The principle behind this is to devise the means by which all options can be selected by a customer (including aesthetical preferences) providing buyer opportunities that competitors are unable to match. Potential drawbacks exist here though including supply chain complications and complexities such choices would initiate. The Conjoint Analysis element of the research model was of particular interest to the organisation regarding this due to it helping to decide upon product features.

The organisation fundamentally does not see any clear barriers to its success either now or in the future. Accordingly, it does not perceive market research, product operations, product design, human resource management or supply chain management to be of concern or issue. Moreover it considers its own products and processes, management, research and development and supply chain management to be strong, successful and proven in ensuring the success of the overall finished product.

- **Suppliers and the Supply Chain**

The organisation has over 100 suppliers and manufactures 50 core products, but when incorporating product extensions and variations, this list extends to 800. Whilst the organisation deals with some degree of supplier challenges, these issues are within the range of 5 to 10% of their overall supplier purchases and tend to come from the same suppliers.

- **Relationship with Suppliers**

As well as receiving regular information updates from suppliers in electronic, paper and verbal formats, *Organisation F* holds regular face-to-face supplier meetings. Text-based information is not always easy to interpret due to the non-English supplier organisations dealt with.

Whilst the company attempts to maintain good information sharing practices with suppliers, one challenge facing the organisation is that its competitors share the same supply chain – the same suppliers deliver all critical components such as gas-carrying parts within the industry. Consequently, it would be potentially damaging for the organisation to share information and designs openly within the supply chain as competitor organisations could subsequently utilise them.

Whilst *Organisation F* is aware of some of its suppliers' corporate and marketing strategies, on the whole such information is not shared yet the organisation believes such sharing would be beneficial.

The company considers supplier relationships to be a high priority and also believes that had there been sufficient advanced supply chain knowledge and information available, it would have made a difference to their organisational growth and strategy. Furthermore, it is believed that improvements in relationships would have made a difference to response from suppliers, different product ranges and different rates of growth, but not necessarily any difference in their set of growth objectives.

The company holds contracts with suppliers of between six months and three years, the difference being based upon how far into the future they wish to fix prices. Prices are usually fixed within a financial year to ensure budget stability for that given time period. Notwithstanding the contracts, the organisation holds different levels of trust between itself and its suppliers – an issue of great importance due to supplier dependence.

Organisation F is aware that many of its supplies are knowledgeable about upcoming and future technologies that could affect their products and also know that some suppliers are actively building such technologies into future components and designs. Whilst acknowledging that some suppliers are doing this, not all of them are making information about developments available, and the company does not believe suppliers are aware of the potential benefits in providing such information to the supply chain. Furthermore it is not believed that all suppliers are aware of issues such as part obsolescence. If they did, the company believes the supply chain as a whole could act as a vehicle for the development and sales of products and that in terms of research, quality, delivery, cost reduction, efficiency, profitability and other such aspects, enhancements could be obtained through closer strategic ties within the supply chain.

- **Suppliers and the Future**

Having acknowledged its dependence upon suppliers, *Organisation F* is reluctant to share future information with them, presenting an acknowledged challenge. Despite this, the company believes suppliers would respond favourably to closer strategic ties and acknowledges the benefit to having supplier input in product design and manufacture. Furthermore, the organisation benefits from information feedback from customers and distributors, and is interested in considering cost, quality, the ability to deliver on time and relationships when considering suppliers.

Suppliers tend to be selected upon their immediate ability to supply required components, rather than developing them to service *Organisation F's* needs. This historical approach requires little interaction between supply chain members and accordingly, *Organisation F* produces products on a

one-off and batch basis. It was acknowledged that this approach would have to change in the future.

In a similar way, most of *Organisation F's* manufacturing equipment is widely available on the market and is not bespoke, and machines that are made to the company's requirements do highly specific tasks. For the future it is acknowledged that this area may develop further – particularly with the introduction of customised production. Furthermore, as more technologically advanced finished products and parts are required, it is envisaged that the new materials being utilised will require more specific tooling and machinery.

- **Vulnerabilities**

Whilst its products are sold on a long-term basis with long periods of time between customer purchases, *Organisation F* controls a sizeable amount of its market yet considers itself to be 25% vulnerable from competitors. Having established the fact that the organisation exports products, 90% of its sales base remains within the UK. The company believes that extending its market share within the EU and the rest of the world could hold long-term benefits, as it would reduce the risk of remaining operational in the UK alone.

To continue manufacturing, the company must comply with changing legislation both within the UK, EU and the rest of the world. It therefore meets all society requirements from the social standpoint. In terms of legal, human resource, personnel, strikes, accidents, criminal, environmental and energy issues, the realistic risks are relatively low for the organisation – between 5% and 10%.

The organisation acknowledges its IT vulnerability whereby it considers itself to be 50% vulnerable. Whilst this could be written off as little more than the need to invest in a new IT infrastructure, it is important to remember that as the organisation is working towards creating a more agile supply chain, an effective and efficient IT infrastructure would be a prerequisite for this, and a risk factor of 50% would not be deemed suitable. This is particularly important when considering the need to interact with other members of the supply chain and ensure that all data is accurate and up-to-date at all times.

The organisation is in a financially fortunate position, as it is not exposed to banks or other financial institutions. It is aware however of external economic risks as well as exchange rates and the cost of borrowing in foreign currencies.

The organisation is also aware of vulnerabilities with regards its relationship with business-to-business exposure and rates this vulnerability at 50%. The company argues that it is difficult to eliminate this quickly or easily whilst having to meet the requirements of individual high-street

retailers and their need for varied products. The importance of maintaining strong relationships in the retail side of the supply chain is therefore of paramount importance to the organisation.

- **Business Environment**

Due to regulatory requirements, the organisation works with environmental factors, as all manufactured products must meet appropriate safety and environmental standards. Furthermore, emissions relating to manufacture and transportation are monitored with both legal and customer requirements in mind. Whilst meeting customer delivery needs, the company is aware of the strains small delivery volumes place on transport networks and subsequently the environment, and takes steps to minimise negative influences.

- **Product**

Organisation F is clear that in terms of the overall finished product it sells, quality, general management, financial management, and human resource management all play a vital role. It is not believed that resource advantages, materials or location hold any particular benefits from the standpoint of the product itself.

Whilst the organisation acknowledges the need to build safety standards into products to meet statutory requirements, component sourcing and product development become more complicated, time-consuming and costly as a result. Such legally imposed external issues make it difficult to maintain product attractiveness in a price sensitive market.

- **Financial Situation**

The organisation manages economic issues through a separate department. Economic issues such as exchange and inflation rates are monitored regularly and stocks are purchased to maximise opportunities with these in mind. Similarly, financial costs are minimised through managing debts and other fiscal costs via the most effective means.

- **Summary Table**

A summary table of findings for Organisation F is presented in Table 5. 9.

Table 5. 9 – Summary of Organisation F Findings (Author)

Organisation F Summary Table	
Level of Competition (Low/Medium/High)	High
Product Complexity (Low/Medium/High)	High
Number of Suppliers	100+
Number of Customers	25
Number of Products Sold	50 key (800 including all line extensions)
Annual Turnover	£45 million
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	Medium
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model Results**

The PFS Model results for *Organisation F* are illustrated in Figure 5. 5 and Table 5. 10.

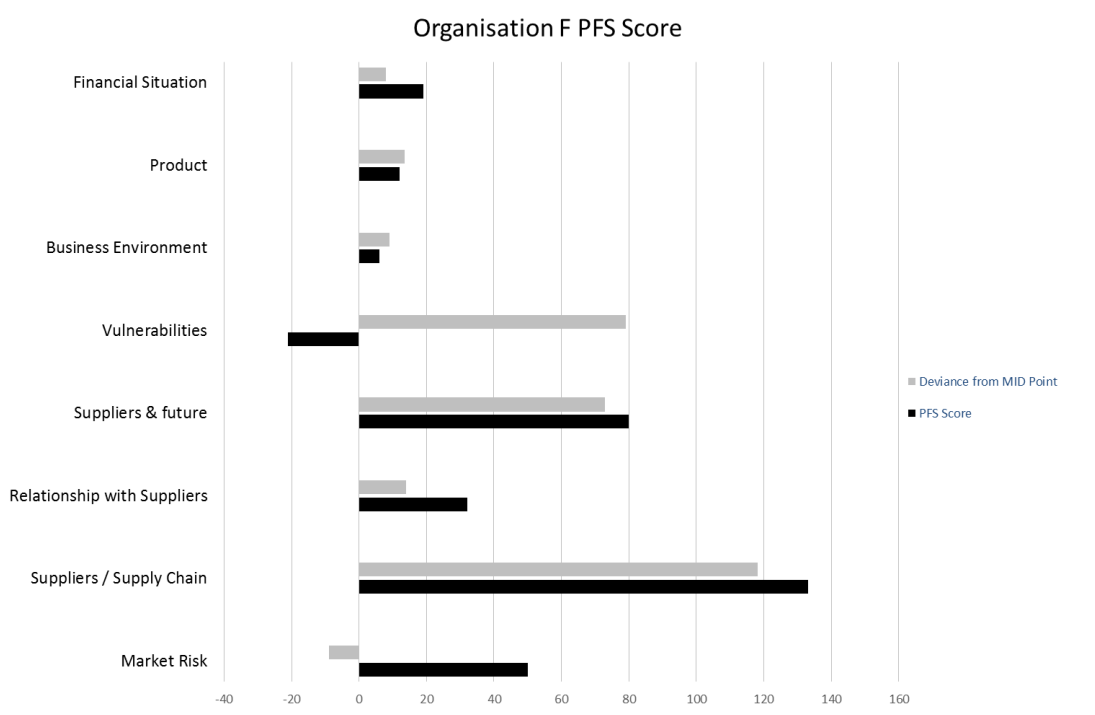


Figure 5. 5 - Organisation F PFS Model Score (Author)

Table 5. 10 - Organisation F PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation F PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	50	7	59	111	85%	-9
Suppliers / Supply Chain	133.1	-18	15	48	887%	118.1
Relationship with Suppliers	32	-14	18	50	178%	14
Suppliers & future	80	-106	7	120	1143%	73
Vulnerabilities	-21	-215	-100	15	21%	79
Business Environment	6	-18	-3	12	-200%	9
Product	12	-120	-1.5	117	-800%	13.5
Financial Situation	19	-31	11	53	173%	8

The PFS Model highlights vulnerabilities as the only significant area of concern for the company, and also accurately emphasises the key findings discussed relating to supplier relationship issues, the market risk, products and the environment.

- **Conjoint Analysis Results**

Organisation F provided data to allow the Conjoint Analysis to be run to consider products and associated design features to subsequently illustrate their relative importance. Three key desirability features were the same for each product line. This data was entered into the Conjoint Analysis and the results identified the relative feature importance as a percentage (illustrated in Table 5. 11).

Table 5. 11 - Conjoint Analysis Results for Organisation F (Author)

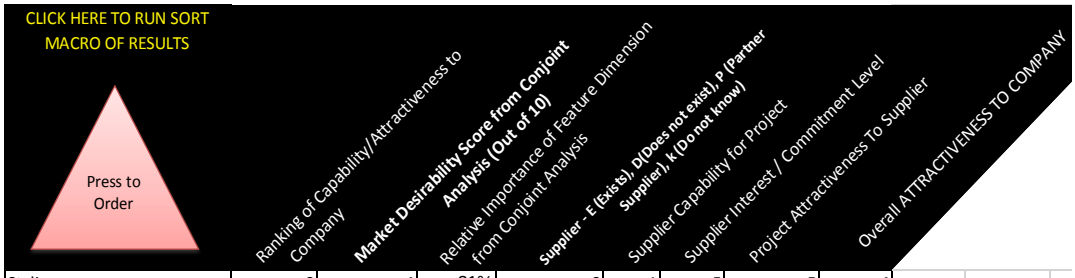
Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Total Average Desirability Score of Feature C		Relative Importance of Each Feature Dimension	
Specification	2.5	Specification	3	Specification	6	Specification	29%
Styling	3.5	Styling	4	Styling	3	Styling	21%
Price	4.5	Price	4	Price	2	Price	50%

These results indicate that *price* is the most important element of a customer purchase, followed by *specification*, and then *styling*. These outputs were subsequently approved by the Operations Manager.

- **Repertory Grid Analysis results**

The *Conjoint Analysis* results were subsequently fed into the *Repertory Grid Analysis*, along with other data supplied by the company. The results are illustrated in Table 5. 12.

Table 5. 12 - Repertory Grid Analysis Results for Organisation F(Author)



	Ranking of Capability/Attractiveness to Company	Market Desirability Score from Conjoint Analysis (Out of 10)	Relative Importance of Feature Dimension from Conjoint Analysis	Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY		
Styling	2	4	21%	3	1	5	5	4		
Specification	3	3	29%	3	5	1	5	6		
Price	1	5	50%	3	5	1	3	9		

From this perspective, the order of interest in terms of developing the agile supply chain is *price, specification* and *styling*.

This data output illustrates that the Conjoint Analysis and Repertory Grid Analysis models work effectively for the data supplied by *Organisation F*. Logically therefore the organisation ought to make future decisions on both the products it makes and the supply chain it develops based upon these key issues (and their order of importance from the perspective of the customer) to both design and manufacture future products. These factors should be considered not only by *Organisation F* but also by its suppliers.

5.6. Case Study Organisation G

Organisation G is a privately owned and operated SME servicing a large local market worth approximately £300 million annually in the field of gardening products and plant supplies. The company predominantly sells directly to customers and commercial clients within a 50-mile radius of its base but has recently expanded its online presence through developing the means to safely ship products and plants, thus expanding to a national market.

The company consists of three divisions and is being developed strategically with a long-term view of the marketplace. The first looks after *residential* clients, creating and delivering garden and household features for homes and individuals. The mark-up on individual items is approximately 100% and the organisation invariably sells its entire stock holding for each event targeted and is noted by customers for its low prices and high quality.

The second division is *commercially* based. Within this arena gardening and horticulturally-based products are sold to commercial clients including schools, rest homes, railway stations and public locations such as highway roundabouts.

The third division is that of *social enterprise.* This element of the business instigates gardening and floral-based improvements for the wider social environment, taking advantage of grants and other such financial scholarships available through both public and private means to improve areas of social interest. The rationale for this side of the business is that it promotes brand awareness, and on-going operations allow company signage to be left at sites being maintained.

The key challenge to the organisation and its ability to expand is a financial one. Financial backers have been found to assist expansion, but due to the size of the commitment involved, Organisation *G* would have to surrender a large element of control to backers, thus losing its independence – something the owner-manager is reluctant to do.

- **Market Risk**

The organisation has 15 key suppliers and makes full use of information provided by them in terms of their market knowledge and resulting marketing opportunities. The company has 10 local competitors and approximately 300 regular customers it relies on for repeat business, as well as a multitude of customers purchasing on a one-off basis.

The organisation is owned and managed by one individual who employs staff according to market needs, eliminating on-going overheads including staffing costs, insurance and large office space requirements. This approach is designed to maximise flexibility and allow the company to respond to market requirements at any time of the year.

The organisation is expanding its market predominantly on a regional basis through its three key divisions of residential, commercial and social enterprise customers, but is having considerable success through its online presence, so a national market angle is evidently operational.

The organisation has quite deliberately no liabilities with banks or other financial institutions. It does make use of free credit from suppliers in some instances, but the majority of suppliers require payment upon delivery. Despite the positive cash flow and healthy profits per unit of sale, the key obstacle facing the organisation is financial in terms of its immediate future, as acquiring larger premises requires a significant financial investment and source of funding.

- **Suppliers and the Supply Chain**

Organisation G works closely with its 15 key suppliers and believes it has clear and regular lines of communication with them but is unaware of their marketing or corporate strategies, believing such information would be beneficial. Despite such communications, information provided by suppliers is not always easy to interpret. Had supplier corporate and marketing strategies been made clear to the company, the owner believes it would have made a difference in terms of speed of growth and the product range carried.

- **Relationship with Suppliers**

The organisation predominantly places individual orders with suppliers rather than working on medium to long-term contracts. It believes there to be a high level of trust, dependence and commitment from suppliers but acknowledges that in terms of communication, information sharing and cost transparency there is a variation in the standards between them. It is predominantly felt that working with suppliers provides positive benefits – the only area of concern being the use of technology that has not been fully implemented within the supply chain.

Whilst the company would like to enhance relationships to assist expansion, it is not believed suppliers would respond favourably to any type of strategic ties or would benefit from them. This is primarily due to the comparatively small turnover of *Organisation G* relative to that of suppliers and the market as a whole.

- **Suppliers and the Future**

The organisation utilises telephone, email and face-to-face communications with suppliers to extend relationships, but despite awareness of the company's customer needs, suppliers do not always meet quality requirements.

Organisation G is aware of suppliers building upcoming technologies into their products and it is also believed that some suppliers are aware of how such technologies affect the sales of *Organisation G*. Some information is forthcoming with regards this technology and the future, but it is felt that suppliers are unaware of the potential benefits in sharing information with *Organisation G* to improve sales. The company believes that developing relationships within the supply chain would positively assist in the design and production of new products and that the communication between itself and suppliers could be both transparent and two-way.

Suppliers could potentially become threats to *Organisation G* in the future should they choose to compete directly and sell to customers. Issues such as delays in supply delivery times could also be seen to be potential threats as well.

- **Vulnerabilities**

Organisation G considers its organisational vulnerability from a strategic perspective. Its overall vulnerability is largely controlled and restricted due to the way in which the organisation operates. Its key areas of weakness in terms of vulnerabilities are shifts in demand and changes in market trends and market competition.

- **Business Environment**

Organisation G's owner-manager is experienced in general business and economic environments and is aware of key economic indicators and their interactions with the organisation as well as the wider economic community the organisation serves. The owner-manager monitors the economic situation accordingly. Due to the nature of the market and the way the organisation interacts with its supply chain, issues such as exchange and interest rates are presently of little significance to the company although this may change in the future as the organisation expands.

- **Product**

The products developed, produced and sold by *Organisation G* are decided upon by active market research that include discussions with customers and the monitoring of product line sales on a daily basis.

The organisation believes itself to be a leader in its field and product development but also considers itself to be reactionary to competitors and responds accordingly. The organisation is continuously meeting new customers and pursuing new product developments. The company utilises the same machinery and personnel as it always has done and therefore requires little investment in these areas.

- **Financial Situation**

As previously indicated, the organisation's management is broadly aware of factors of economics – both micro and macro – and how they interact with the organisation. As the organisation is effectively self-financing at present without any debts, there are few concerns with regards economics outside the potential fall in sales due to potential tax rises and interest that could be levied from a macro-economic perspective. The knock-on effect of such hikes could slow sales down. Having made this point, *Organisation G's* market has not been particularly affected during the financial slowdown of recent years. Moreover many competitors have managed to expand during this time whilst high-street retailers have not always performed as well.

- **Summary Table**

A summary table of findings for Organisation G is presented in Table 5. 13.

Table 5. 13 – Summary of Organisation G Findings (Author)

Organisation G Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	Multiple
Product Complexity (Low/Medium/High)	Medium
Number of Suppliers	15
Number of Customers	300
Number of Products Sold	11
Annual Turnover	£150,000
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	Medium
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model Results**

The PFS Model results for *Organisation G* are illustrated in Figure 5. 6 and Table 5. 14.

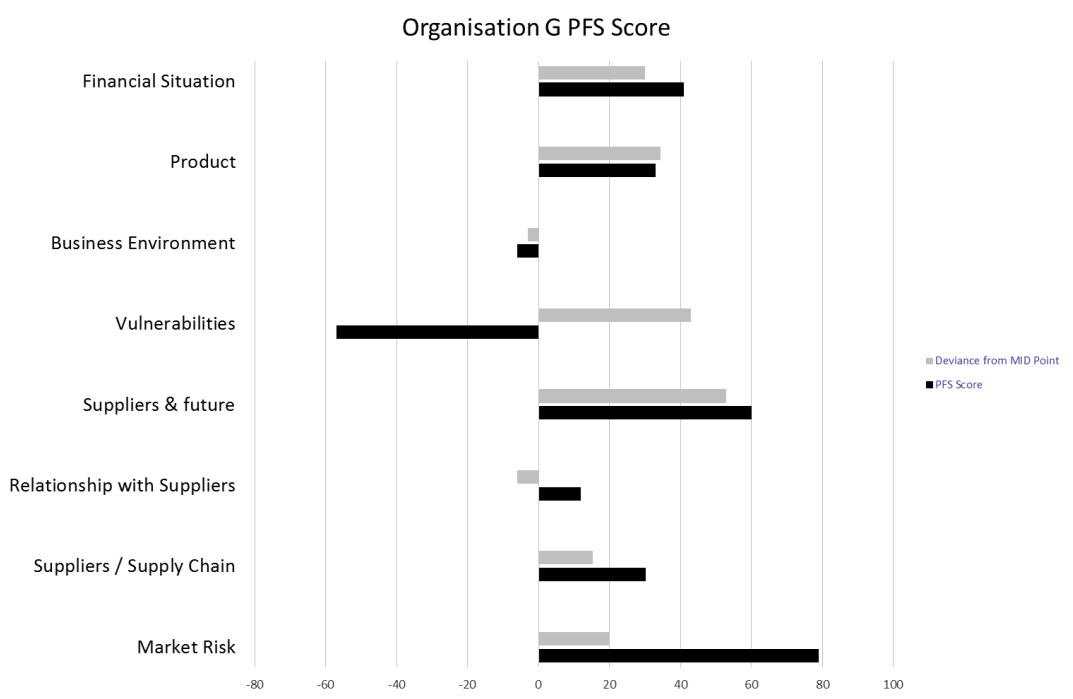


Figure 5. 6 - Organisation G PFS Model Score (Author)

Table 5. 14 - Organisation G PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation G PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	79	7	59	111	134%	20
Suppliers / Supply Chain	30.3	-18	15	48	202%	15.3
Relationship with Suppliers	12	-14	18	50	67%	-6
Suppliers & future	60	-106	7	120	857%	53
Vulnerabilities	-57	-215	-100	15	57%	43
Business Environment	-6	-18	-3	12	200%	-3
Product	33	-120	-1.5	117	-2200%	34.5
Financial Situation	41	-31	11	53	373%	30

The PFS Model highlights vulnerabilities and the environment as being the only significant areas of concern for the company. It also accurately emphasises the key findings discussed relating to the supply chain, supplier relationship issues, suppliers and the future, the market risk and products.

- **Conjoint Analysis Results**

Organisation G was able and keen to provide data to run a Conjoint Analysis as it was in the process of identifying ways to simplify product lines and reduce stock holding costs. One related consideration was whether or not it held too many variations of similar themes in stock in each different line, thus making it difficult for customers to make purchase choices (potentially resulting in lost sales and increasing stock holding costs). This was a point of particular interest with regards the research as the organisation was effectively interested in product features. The Conjoint Analysis was run for one particular product line to test its applicability and the results are illustrated in Table 5. 15. For this product, the customer has a choice from four features, and within each feature one component must be selected.

Table 5. 15 - Conjoint Analysis for Organisation G (Author)

Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Total Average Desirability Score of Feature C		Total Average Desirability Score of Feature D		Relative Importance of Each Feature	
Daffodil	22	Daffodil	5	Daffodil	5	Daffodil	8	Daffodil	71%
Pansy	4	Pansy	7	Pansy	8	Pansy	17	Pansy	7%
Primrose	16	Primrose	6	Primrose	6	Primrose	11	Primrose	11%
Ivy	16	Ivy	7	Ivy	7	Ivy	14	Ivy	11%

These results were considered by the owner-manager to be particularly accurate, significant and in line with historical data and future expectations.

- **Repertory Grid Analysis results**

The Repertory Grid Analysis was also of interest to the company due to its product line simplification exercise. The results are illustrated in Table 5. 16.

Table 5. 16 - Repertory Grid Analysis for Organisation G (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis**	Relative Importance of Feature Dimension to MARKET from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)** Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Product Feature	Overall ATTRACTIVENESS TO COMPANY
Daffodil	1	22	71%	3	5	5	1	A	26
Pansy	1	8	71%	3	5	5	1	D	17
Primrose	1	5	71%	3	5	5	1	B	15
Ivy	1	5	71%	3	5	5	1	C	14
Ivy	1	16	11%	3	5	5	1	A	3
Primrose	1	16	11%	3	5	5	1	A	3
Daffodil	1	14	11%	3	5	5	1	D	3
Pansy	1	11	11%	3	5	5	1	D	3
Pansy	1	7	11%	3	5	5	1	B	2
Ivy	1	7	11%	3	5	5	1	C	2
Ivy	1	6	11%	3	5	5	1	C	2
Primrose	1	6	11%	3	5	5	1	B	2
Daffodil	1	17	7%	3	5	5	1	D	2
Primrose	1	8	7%	3	5	5	1	C	2
Daffodil	1	7	7%	3	5	5	1	B	1
Pansy	1	4	7%	3	5	5	1	A	1

These results were also considered to be particularly relevant and accurate by the owner-manager. Whilst neither considered nor relevant in this research, the model was used across a number of other products for the company and the results utilised to simplify the product lines resulting in an increase in sales of over 600%, indicating the relevance of the Conjoint and Repertory Grid Analyses tools in line with the PFS Model. Such were the results that the owner made use of them to establish a range for the following Christmas and is keen to maintain the models for foreseeable developments.

5.7. Case Study Organisation H

Organisation H is a privately owned and operated SME manufacturing calibration equipment, certified reference materials and laboratory reagents. The company sells its 500 products internationally in a highly competitive business to approximately 1900 customers. Its £1.6 million turnover has been increasing in the last three years at between 10 and 15%.

- **Market Risk**

The company is in the growth stage of the product life cycle and can clearly identify the market for each product it sells. Its corporate and marketing strategies are clearly understood, aligning to customer needs whilst operating in a large, profitable market. Potential barriers that might affect operations over the next five years are known and matters are in hand to manage such situations.

- **Suppliers and the Supply Chain**

The company can highlight its key suppliers and believes it has strong relationships with them – the maintenance of which is deemed to be of high priority. Supplier issues are limited, and those that do occur tend to come from the same suppliers. Regular supplier meetings are held to maintain relationships and easily understood information updates are also received, but on a less regular basis. Senior management believe knowledge of supplier corporate and marketing strategies would be beneficial, but this information is not forthcoming.

- **Relationship with Suppliers**

The organisation has positive relationships with its suppliers, and whilst some contracts are for no more than individual orders, many are based upon long-term relationships of more than four years. Resultantly, trust and commitment between the partners is strong and a high level of information sharing and cost transparency exists between those involved that has enabled new products to be developed utilising new technologies. This point is particularly important, as the directors believe strong relationships between supply chain members to be key to growth.

However, the organisation is aware that suppliers do not necessarily provide adequate information about new technologies that could be built into new products, resulting in the supply chain as a whole missing out on potential expansion.

- **Suppliers and the Future**

The company is committed to working closely with suppliers and believes the supply chain as a whole could act as a means to enhance both products and market share in the future. The directors highlighted how strong relationships between supply chain members could influence strategic growth and product development, based upon trust, commitment, and open and effective communication.

Whilst highlighting the positive aspect of the relationships existing between the company and its suppliers, the directors identified that suppliers were not aware of potential benefits to providing information regarding new technologies to be built into future products. Equally so, suppliers are not aware of potential part obsolescence.

- **Vulnerabilities**

The organisation believes itself to be strategically vulnerable. The key areas relating to this are based upon human resource issues and personnel loss. All other potential areas of vulnerability including societal and technical were not deemed to be of any importance.

- **Business Environment**

As 82% of product sales are for export, the company monitors exchange rates accordingly. It does not monitor financial institution borrowing rates and absorbs supply inflationary costs as much as possible so as not to pass them on to customers.

- **Product**

The specialised products are recognised for their high quality and innovativeness helping to provide unique selling points to the international market. Company directors believe the company to be a product leader but at the same time acknowledge that products sometimes emerge as a reaction to market competition and as a result of customer requirements. This assists in the process of introducing customers to the company and in maintaining existing customers.

A new product can consist of up to 50% new technology, and can be manufactured as one off, small batch, large batch or continuous processes, predominantly using the same machinery that has been used for previous products. Machinery tends to be modified rather than specifically created for new products.

All product designs are original and produced in house. Accordingly, staff are given general skill training and where necessary specific skill training to assist in new product development. Company directors believe that barriers to product success exist in the areas of market research, product design and human resource availability.

- **Financial Situation**

The organisation monitors factors of macroeconomics that help it to plan and adapt to future markets. Its financial exposure to suppliers is minimal and it carries no financial debts.

- **Summary Table**

A summary table of findings for Organisation H is presented in Table 5. 17.

Table 5. 17 – Summary of Organisation H Findings (Author)

Organisation H Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	Multiple (international)
Product Complexity (Low/Medium/High)	High
Number of Suppliers	150
Number of Customers	1900
Number of Products Sold	500
Annual Turnover	£1.6 million
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	High
Level of Uncertainty and change within Business Environment (Low/Medium/High)	Medium

- **PFS Model Results**

The PFS Model results for *Organisation H* are illustrated in Figure 5. 7 and Table 5. 18.

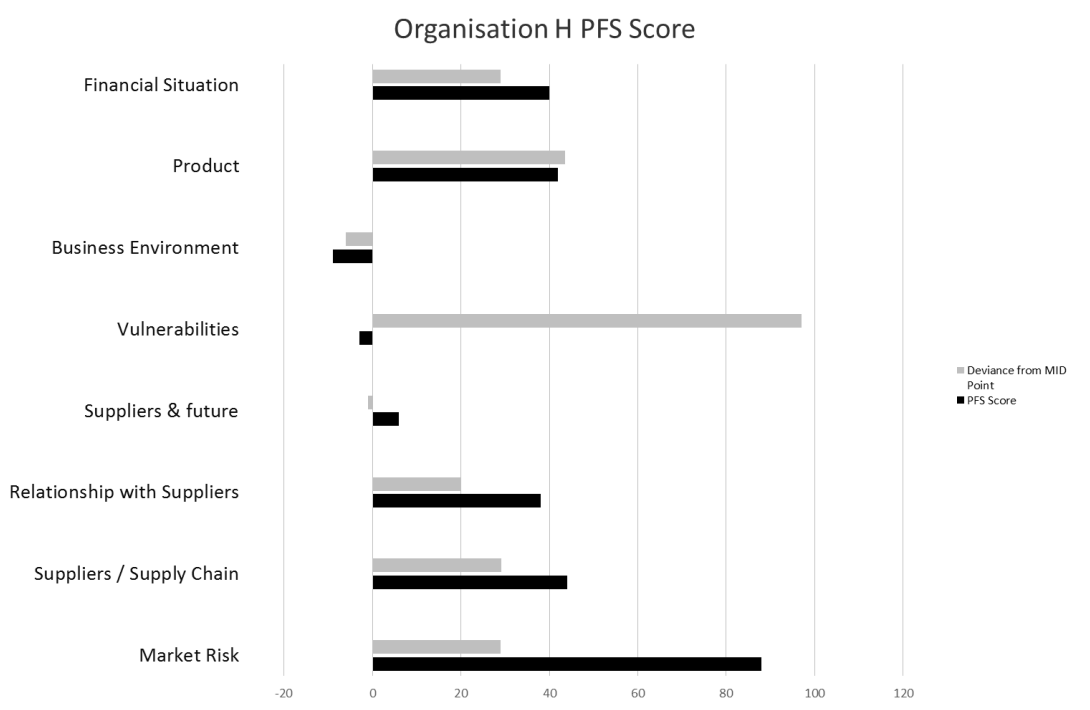


Figure 5. 7 - Organisation H PFS Model Scores (Author)

Table 5. 18 - Organisation H PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation H PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	88	7	59	111	149%	29
Suppliers / Supply Chain	44.05	-18	15	48	294%	29.05
Relationship with Suppliers	38	-14	18	50	211%	20
Suppliers & future	6	-106	7	120	86%	-1
Vulnerabilities	-3	-215	-100	15	3%	97
Business Environment	-9	-18	-3	12	300%	-6
Product	42	-120	-1.5	117	-2800%	43.5
Financial Situation	40	-31	11	53	364%	29

The PFS Model highlights vulnerabilities, the environment and economics as being the only significant areas of concern for the company. It also accurately emphasises the key findings discussed relating to the supply chain, supplier relationships, suppliers and the future, the market risk and products.

- **Conjoint Analysis Results**

Organisation H was able to provide data for use in a Conjoint Analysis – the results of which are illustrated in Table 5. 19.

Table 5. 19 - Conjoint Analysis Results for Organisation H (Author)

Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Desirability Score of Feature C		Relative Importance of Feature Dimension	
Certified by users	5	Accreditation 7025	6	Volume A	7	Certification	14%
Certified values	4	Accreditation Guide 34	4	Volume B	3	Accreditation	29%
						Volumes	57%

This clearly illustrates the relative importance of the feature dimensions and falls in line with organisational expectations.

- **Repertory Grid Analysis results**

Organisation H was able to provide data for use in a Repertory Grid Analysis – the results of which are illustrated in Table 5. 20 and align with organisational expectations.

Table 5. 20 - Repertory Grid Analysis Results for Organisation H (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS (Press to Order)	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)**	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Accreditation 7025	1	6	29%	3	5	3	3	21
Accreditation Guide 34	1	4	29%	3	5	3	5	21
Certified values	1	4	14%	3	5	3	5	21
Certified by users	1	5	14%	3	5	3	5	22
Volume B	6	3	57%	3	5	3	3	23
Volume A	1	7	57%	3	5	3	5	24

5.8. Case Study Organisation K

Organisation K is an SME providing foot care products and services at both its own outlets and, when necessary, to customers at a location of their choosing. The company employs a limited number of qualified personnel, contracting others as and when needed. Whilst the service offering is standardised utilising similar tools and equipment for each patient, the product offerings are bespoke to the needs of the individual, providing medical and athletic support to customers when standardised off-the-shelf products are unsuitable.

Competition comes from both the public and private sectors, yet whilst the NHS can be seen to be competing in certain areas of the market, the owner believes waiting lists and appliance limitations deriving from NHS Trusts enhance the private market for both the services provided and the products made for customers.

- **Market Risk**

The company is in the growth segment of the product life cycle and can clearly define its market and corporate strategies, servicing private customers as well as care and nursing homes through contracts. Irrespective of the contacts, the company services customer needs on an individual basis. The care packages are standardised, and the owners are aware of the potential obsolescence of equipment and materials.

The products sold are not generally standardised and those that are usually require some element of bespoke work to ensure they meet customer requirements. The market is suitably attractive for the company to operate in, with barriers to operation being the availability of labour and finance, environmental and employee regulations, the cost of labour and the intensity of competition.

- **Suppliers and the Supply Chain**

The company predominantly deals with three suppliers, experiencing limited issues regarding quality or delivery. Regular information updates are provided from suppliers but face-to-face meetings are irregular and nothing is known of supplier marketing or corporate strategies. A limited number of non-interchangeable products are available from specific suppliers, and it is this along with product quality that assists in continuing supplier relationships. When supplier issues occur they tend to be resolved quickly as suppliers are aware of the ease with which customers can swap allegiance.

- **Relationship with Suppliers**

All orders are made on an individual basis depending upon the monthly workload and the needs of customers. The organisation trusts suppliers and is satisfied with the levels of communication, information shared and the costs of supplies. Meetings have resulted in the introduction of new technologies from suppliers that have resultantly opened up new market possibilities. In some examples provided, cost reductions came about as a result of such discussions and one supplier in particular is keen to extend the relationship as a means of developing market research. When suppliers fail to meet the expected quality standard it is possible to find alternative supplies but there are costs associated with this and it is avoided whenever possible.

- **Suppliers and the Future**

Suppliers are aware of upcoming technologies and are keen to build them into new products that would subsequently assist *Organisation K*. The owner believes the supply chain as a whole could benefit from closer integration but considers it unlikely to happen due to competitive forces. There is evidence of the company interacting with suppliers and a degree of transparency existing within the relationship – communications take place predominantly via telephone and email discussions but occasional face-to-face meetings provide evidence of forward-thinking operations, illustrated in the example of one supplier discussing manufacturing operations to improve product quality and minimise costs.

Despite this, suppliers are always judged by the quality of their products, their delivery times and costs. Suppliers are aware of this and the ability to switch suppliers – maintaining customers is so important for one supplier that the owner provided an example of a contractor making a 400-mile journey to ensure materials arrived on time having acknowledged an error created by their on-line ordering system.

- **Vulnerabilities**

The key vulnerabilities the company faces are financial, human resource and market based. Employing qualified and suitable personnel is seen as an essential element of the future of the company as a result of this.

- **Business Environment**

The company operates within environmental regulations relating to the disposal of used equipment, chemicals and old components, factoring these into their operating costs. Whilst the company is aware of its environmental footprint regarding emissions and equipment disposal, there is little it can do to affect matters due to legislation.

- **Product**

The company delivers high quality products and services to customers on a needs basis. However, certain products have been developed that are now in widespread use including specialised pain minimising cushioning. In such product development, the company tends to utilise existing materials but has approached suppliers with the view to co-developing new components when the market has been deemed large enough. Such product development has required employee skill updates as the design and testing has been completed in-house. It has also required interaction with appropriate personnel to ensure patents are acquired.

- **Financial Situation**

The company does not monitor exchange rates as any alterations thereof and associated costs are incorporated into supplies that are subsequently passed onto customers. Financial institutions are not monitored for the lowest rates of borrowing due to the company utilising minimal levels of overdraft facilities, but free debt in the form of delayed payment for supplies is sometimes used. Certain supplies are purchased in bulk and stored to minimise inflationary costs and to take advantage of bulk orders.

- **Summary Table**

A summary table of findings for Organisation K is presented in Table 5. 21.

Table 5. 21 – Summary of Organisation K Findings (Author)

Organisation K Summary Table	
Level of Competition (Low/Medium/High)	Medium
Number of Key Competitors	10+ at each outlet
Product Complexity (Low/Medium/High)	High
Number of Suppliers	5
Number of Customers	100s
Number of Products Sold	5
Annual Turnover	<£100,000
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	High
Level of Uncertainty and change within Business Environment (Low/Medium/High)	High

- **PFS Model Results**

The PFS Model results for *Organisation K* are illustrated in Figure 5. 8 and Table 5. 22.

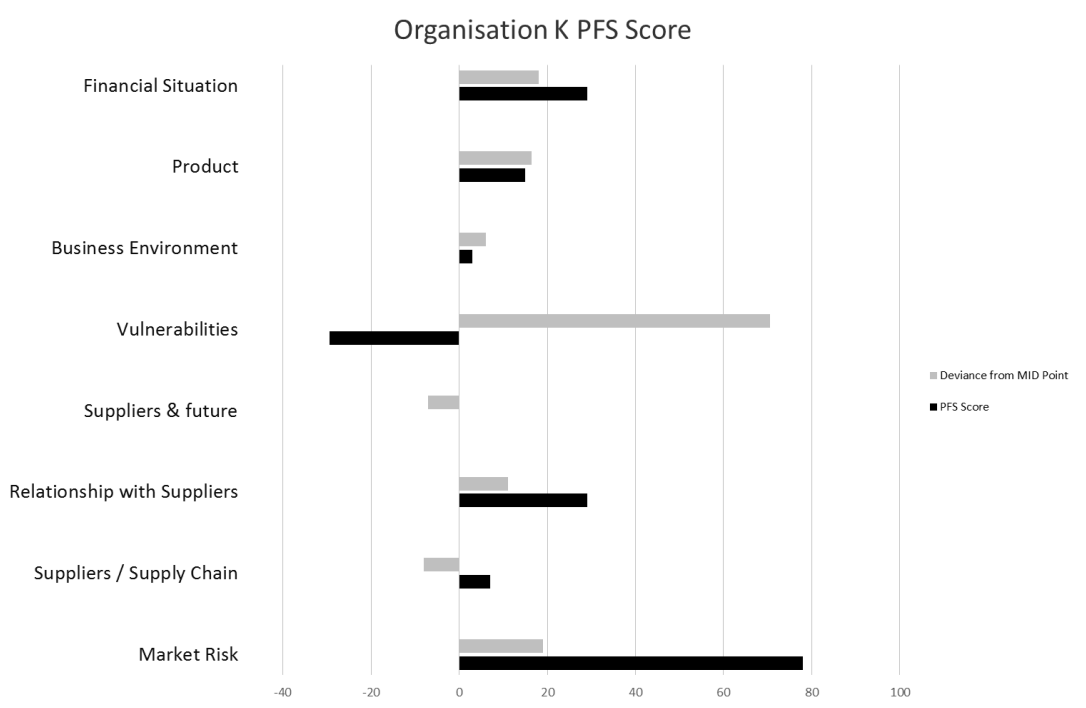


Figure 5. 8 – Organisation K PFS Model Scores (Author)

Table 5. 22 – Organisation K PFS Model Scores (Author)

QUESTIONNAIRE AREA	Organisation K PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	78	7	59	111	132%	19
Suppliers / Supply Chain	7	-18	15	48	47%	-8
Relationship with Suppliers	29	-14	18	50	161%	11
Suppliers & future	0	-106	7	120	0%	-7
Vulnerabilities	-29.5	-215	-100	15	30%	70.5
Business Environment	3	-18	-3	12	-100%	6
Product	15	-120	-1.5	117	-1000%	16.5
Financial Situation	29	-31	11	53	264%	18

The PFS Model highlights vulnerabilities as being the only significant area of concern for the company. It also accurately emphasises the key findings discussed relating to the supply chain, supplier relationship issues, suppliers and the future, the market risk and products. A point of interest here comes from the suppliers and the future category, which is neutral – a view that came across during the questionnaire-interview.

- **Conjoint Analysis Results**

Organisation K was able to provide data to run a Conjoint Analysis, the results of which are illustrated in Table 5. 23.

Table 5. 23 - Conjoint Analysis Results for Organisation K (Author)

Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Total Average Desirability Score of Feature C		Relative Importance of Each Feature Dimension	
Nail Care	13	Therapeutic	10	Simple	14	Pedicure	23%
Debridement	10	Medicinal	9	Bespoke	12	Massage	7%
Enucleation	10			Footwear	4	Orthotics	70%

These results proved to be in line with the company's expectations, illustrating the product features end users require most to be orthotics.

- **Repertory Grid Analysis results**

Organisation K was able to provide data for use in a Repertory Grid Analysis – the results of which are illustrated in Table 5. 24 and align with organisational expectations.

Table 5. 24 – Repertory Grid Analysis Results for Organisation K (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS

Press to Order

	Ranking of Capability/Attractiveness to Company		**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)**	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Footwear	1	4	70%	3	5	1	1	15	
Bespoke	2	12	70%	3	5	1	1	24	
Enucleation	3	10	23%	3	5	1	3	25	
Debridement	3	10	23%	3	5	1	5	27	
Medicinal	6	9	7%	3	5	1	3	27	
Nail care	3	13	23%	3	5	1	5	30	
Therapeutic	7	10	7%	3	5	1	5	31	
Simple	8	14	70%	3	5	1	5	36	

These results were supported by the company owner who agreed with the outcomes. However, they appear potentially misaligned when considering the results from the Conjoint Analysis. Whilst orthotic work (illustrated in the Conjoint Analysis in Table 5. 23, page 176) is the most important feature dimension of the work carried out, its use in *footwear* and *bespoke* (illustrated in the Repertory Grid Analysis in Table 5. 24) are costly and labour intensive, resulting in their overall attractiveness being diminished (from a profitability perspective) by the company, whilst *simple* orthotics are less intensive and therefore more attractive to the organisation. All other feature attractiveness results align with organisational expectations.

5.9. Case Study Organisation L

Organisation L is an SME manufacturing standardised and speciality cakes for both private, corporate and public organisation customers. The company employs key staff, but employs others at times of high demand, depending upon the skill base required for the task.

The company has a number of key clients providing regular repeat business, but every order is unique and traditional forms of mass production have never been considered. The company has however contemplated automating elements of its production process as well as expanding from its present premises in line with such automation. Subcontracting elements of the production process have also been considered, but the owner believes the investment levels required would not substantiate the net outcomes at the present time.

- **Market Risk**

The company is in the introduction-growth stage of its market, believing itself to be in the position to continue growing for the foreseeable future. Products are sold predominantly directly to customers and accordingly the company can clearly define its marketing strategy and product obsolescence.

The owner is aware of competition from both local competitors and national chains and cites automation and production economies of scale from larger competitors to be a key factor in this. These dynamics are responsible for the low profitability carried by many of the lines produced, yet the company is convinced of the long-term market attractiveness.

Key areas of concern for the company include finance, environmental regulations, labour costs and employment regulations, the availability of employees with suitable skills, the intensity of competition and supplier cost pressures.

- **Suppliers and the Supply Chain**

The company can highlight its key suppliers, but receives little support from them in terms of communication, information, their corporate or marketing strategies or their interest in supporting the future of the organisation. The owner believes this to be simply due to the size of the company relative to market.

- **Relationship with Suppliers**

Whilst the organisation bulk purchases some supplies (storing them for up to six months), most purchases are made on an individual basis following past experiences. Whilst product quality is high, trust in suppliers is low due to the low levels of communication, common information sharing and cost transparency experienced throughout the supply chain. The consequence of this being that knowledge of future products being released by suppliers has little immediate impact in the marketplace. Interactions with suppliers that have taken place have improved cost, quality, delivery rates, flexibility and performance. The company subsequently believes that suppliers would benefit from closer strategic ties.

- **Suppliers and the Future**

The owner does not believe that suppliers are actively building new technology into future products, nor are they considering how such technologies could affect companies such as *Organisation L*, yet it is believed that the supply chain as a whole could benefit and act as a vehicle for the future development and sales of products.

Organisation L has no experience of supplier interaction with regards customer needs, yet believes improved relationships would assist in growth and the opening up of markets. Having made these points, *Organisation L* operates on the basis of purchasing high-quality supplies at what it perceives to be reasonable costs that arrive on time. Lack of technological support and any other complementary benefits accompanying the said supplies are of less interest.

- **Vulnerabilities**

The organisation considers itself to be vulnerable from a strategic perspective (due to high street brand competition), and is also aware of its vulnerability relating to societal and market changes as well as legal, energy and environmental issues.

- **Business Environment**

As the majority of products are made for the regional market, the organisation monitors regional trends, adapting product and sales literature accordingly. It also monitors international and cultural trends for future product ideas.

- **Product**

Due to the predominantly bespoke nature of the products sold, the organisation is primarily interested in creating high-quality, innovative outputs to meet individual customer requirements. Despite the unique nature of these products, there are media-established market trends the organisation follows to meet customer requirements.

The high quality and levels of innovation within the products are in part responsible for introducing new customers and ensuring the return of old customers. Accordingly, all staff partake in on-going training and must maintain high skill levels with both traditional and specialised equipment used in manufacture.

- **Financial Situation**

The organisation has been built up over time and accordingly carries no debt, subsequently having no need for tracking of interest or exchange rates. The company monitors inflation rates and makes purchases accordingly, buying in bulk and storing supplies to minimise costs.

- **Summary Table**

A summary table of findings for Organisation L is presented in Table 5. 25.

Table 5. 25 – Summary of Organisation L Findings (Author)

Organisation L Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	Multiple (5+ locally, innumerable nationally)
Product Complexity (Low/Medium/High)	High
Number of Suppliers	8
Number of Customers	100s
Number of Products Sold	30
Annual Turnover	<£100,000
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	Low
Level of Uncertainty and change within Business Environment (Low/Medium/High)	High

- **PFS Model Results**

The PFS Model results for *Organisation L* are illustrated in Figure 5. 9 and Table 5. 26.

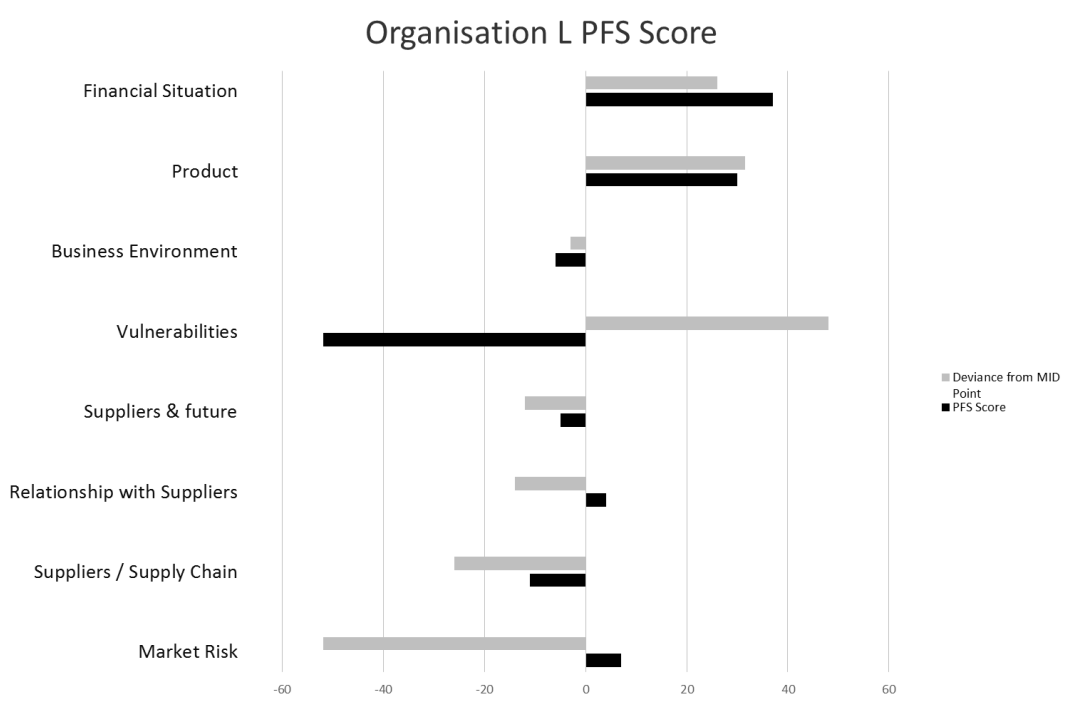


Figure 5. 9 - Organisation L PFS Model Score (Author

Table 5. 26 - Organisation L PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation L PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	7	7	59	111	12%	-52
Suppliers / Supply Chain	-11	-18	15	48	-73%	-26
Relationship with Suppliers	4	-14	18	50	22%	-14
Suppliers & future	-5	-106	7	120	-71%	-12
Vulnerabilities	-52	-215	-100	15	52%	48
Business Environment	-6	-18	-3	12	200%	-3
Product	30	-120	-1.5	117	-2000%	31.5
Financial Situation	37	-31	11	53	336%	26

With the exceptions of product, economic, relationship with suppliers and the market risk, the PFS Model illustrates a challenging situation for *Organisation L*. The results were confirmed by the owner as being a realistic overview of the operating situation.

- **Conjoint Analysis Results**

Organisation L was able to provide data to run a Conjoint Analysis, the results of which are illustrated in Table 5. 27.

Table 5. 27 - Conjoint Analysis Results for Organisation L (Author)

Total Average Desirability Score of Feature A		Total Average Desirability Score of Feature B		Total Average Desirability Score of Feature C		Relative Importance of Each Feature Dimension	
Recipe A	13	Personalisation L1	10	Royal Icing	5	Recipe	36%
Recipe B	10	Personalisation L2	10	Rolled Icing	14	Personalisation	11%
Recipe C	7	Personalisation L3	9			Icing Type	53%

These results are in line with company expectations, and illustrate the primary feature of customer importance being the *icing type* (Desirability Feature C in Table 5. 27).

- **Repertory Grid Analysis results**

Organisation L was able to provide data for use in a Repertory Grid Analysis – the results of which are illustrated in Table 5. 28 and align with organisational expectations.

Table 5. 28 - Repertory Grid Analysis Results for Organisation L (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS Press to Order	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), k (Do not know)**	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Personalisation L3	1	9	11%	3	5	1	1	20
Recipe C	3	7	36%	3	5	1	1	**20**
Royal Icing	7	5	53%	3	5	1	1	23
Recipe B	3	10	36%	3	5	1	1	23
Personalisation L2	5	10	11%	3	5	1	1	25
Rolled Icing	2	14	53%	3	5	1	1	27
Personalisation L1	8	10	11%	3	5	1	1	28
Recipe A	6	13	36%	3	5	1	1	29

The company owner agreed with the outcomes and supported these results, confirming that future products would primarily be based upon the three most attractive options of *rolled icing, Personalisation L1* and *Recipe A*. Having made this point, the level of personalisation for all products is such that any variations are possible, but the primary focus for product development will be based upon these three elements. The company is fundamentally aware of its situation and agreed with the outputs of each model. Whilst these model outputs are unlikely to affect future operations for the organisation, the owner's response validated their effectiveness.

5.10. Case Study Organisation N

Organisation N is an SME operating a number of healthcare premises, providing bespoke products and services to customers. Whilst some clients utilise these services as a private alternative to the NHS, others such as athletes incorporate the services into their training, recovery and well-being regimes. The organisation is able to provide bespoke products that supplement and support training equipment and clothing. Alongside these services, the organisation manufactures, sells and distributes its own range of health and skin care products based upon the requirements of patients and athletes. These are sold at all company premises as well as via dedicated and third party websites.

Whilst the owner highlighted the potential market to be large, no indication of turnover was given for either the company as a whole or its constituent elements.

- **Market Risk**

The company is in the growth stage of its product life cycle and can identify the market for each product and service and its overall corporate strategy. Whilst it does maintain some corporate clients, the majority of revenue comes from end users. Accordingly, the organisation is aware of its marketing strategy, the intensity of competition, its potential market and the relative profitability at each site. The owner believes it faces only two significant barriers over the next five years – the availability of labour and transport networks.

- **Suppliers and the Supply Chain**

The organisation only orders supplies as and when needed on an individual basis. It has established strong levels of trust, dependence and commitment and maintains a high level of communication with its suppliers. Further to this and high levels of information sharing, the company has benefited from the technologies to open new product ranges and improve its quality and delivery.

- **Relationship with Suppliers**

The company is aware of its main supplier activities and the owner maintains regular face-to-face meetings as well as electronic information updates from suppliers. The company is not aware of supplier corporate or marketing strategies and believes this could help in the future, but ultimately believes supplier relationships to be of low priority relative to other business activities.

Whilst the company believes suppliers would respond favourably to closer strategic ties, there is no cost transparency throughout the supply chain. The company does not believe this to be an issue and does not perceive supply chain issues to hold any obstacles to its future development.

- **Suppliers and the Future**

The company is aware of the strength of suppliers in terms of building technologies into products and supplies and how they will affect future products and services. Through on-going relationships, suppliers are aware of potential benefits in providing *Organisation N* with information regarding upcoming technologies. This transparent information flow is beneficial to both organisations and the owner believes the supply chain as a whole could benefit from extending such a relationship. However, the owner of *Organisation N* acknowledges that key suppliers work with possibly several thousand businesses in the supply chain and consequently such an extended relationship is unlikely.

Organisation N is keen to maintain supply chain relationships with the view of opening up new markets and developing growth through enhanced communication, trust, commitment and process integration, provided the delivery of high quality, cost-effective products can be maintained.

- **Vulnerabilities**

The company considers itself strategically vulnerable and influenced by economic and social trends. Whilst different organisational locations hold varying degrees of vulnerability, key issues of concern for the company are legal and human resource based - the fundamental concern here being ensuring appropriately qualified personnel can be employed at each site.

- **Business Environment**

All sales are presently for the home market, and whilst the owner monitors exchange rates for investment purposes, the company is unaware of costs attributed to exchange rates emanating from suppliers. The owner is aware of wider economic issues and monitors bank rates for the lowest borrowing costs.

- **Product**

Whilst key to the company's success are innovation and quality, the owner does not believe the company to be a market leader – instead it utilises customer requirements and market information to develop new products and services.

Customer services are provided on a one-off basis, bespoke customer products are made on a one-off basis and health products on a batch-basis, utilising generally available machinery and supplies that have been used on previous products. Some consideration has been given to having batch-based products made by third parties to reduce time and costs, but quality considerations and the drive for customer satisfaction has to date held this option back.

Product designs are often specialised with parts being designed through cooperation with suppliers via a well-managed and structured process. However, the company acknowledges on-going barriers arise from its production operations, human resource and supply chain management, and these provide long-term challenges – particularly in terms of finding reliable suppliers of natural products.

- **Financial Situation**

The company is largely self-financing but does monitor financial institution rates of borrowing to minimise operating costs. It also utilises free debt via delayed payments to suppliers. Whilst the company purchases supplies when it perceives them to be a good deal, inflation rates are not taken into account on a regular basis when making such purchases.

- **Summary Table**

A summary table of findings for *Organisation N* is presented in Table 5. 29

Table 5. 29 – Summary of Organisation N Findings(Author)

Organisation N Summary Table	
Level of Competition (Low/Medium/High)	Medium / High
Number of Key Competitors	10
Product Complexity (Low/Medium/High)	High
Number of Suppliers	3
Number of Customers	1000s
Number of Products Sold	10+
Annual Turnover	<£250,000
Financial Liability	Low
Overall Relationship with Suppliers (Low/Medium/High)	Medium
Level of Uncertainty and change within Business Environment (Low/Medium/High)	High

- **PFS Model Results**

The PFS Model results for *Organisation N* are illustrated in Figure 5. 10 and Table 5. 30.

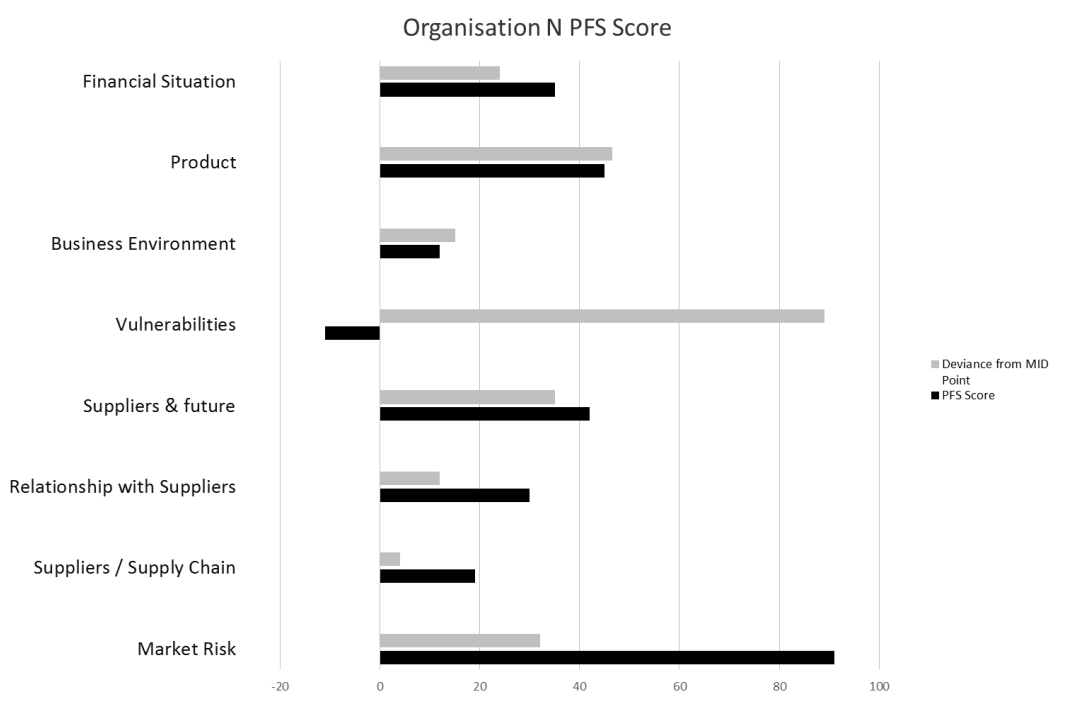


Figure 5. 10 - Organisation N PFS Model Score (Author)

Table 5. 30 - Organisation N PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation N PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	91	7	59	111	154%	32
Suppliers / Supply Chain	19.01	-18	15	48	127%	4.01
Relationship with Suppliers	30	-14	18	50	167%	12
Suppliers & future	42	-106	7	120	600%	35
Vulnerabilities	-11	-215	-100	15	11%	89
Business Environment	12	-18	-3	12	-400%	15
Product	45	-120	-1.5	117	-3000%	46.5
Financial Situation	35	-31	11	53	318%	24

With the exceptions of vulnerabilities (that the company is strategically open to due to the nature of the market in which it operates), the PFS Model illustrates strong scores for the company and the owner has confirmed these results as being accurate.

- **Conjoint Analysis Results**

Organisation N was able to provide data to run three Conjoint Analyses for their separate operating areas, the results of which are illustrated in Table 5. 31, Table 5. 32 and Table 5. 33.

Table 5. 31 - Conjoint Analysis Results for Organisation N, Foot Care (Author)

Total Average Desirability Score of Feature A (Biomechanics)		Total Average Desirability Score of Feature B (Foot Care)		Total Average Desirability Score of Feature C (Routine)		Relative Importance of Each Feature Dimension	
Foot Functions	7	Nail Care	5	Corns	6	Biomechanics	57%
Foot Shape Analysis	3	Advice	4	Callouses	4	Foot Care	14%
						Routine	29%

Table 5. 32- Conjoint Analysis Results for Organisation N, Skin Care (Author)

Total Average Desirability Score of Feature A (Natural Products)		Total Average Desirability Score of Feature B (Function/Size)		Total Average Desirability Score of Feature C (Packaging/Ethos)		Relative Importance of Each Feature Dimension	
Oils	4	50g	5	Recyclable	5	Natural Products	54%
Scents	10	100g	8	Refillable	8	Function / Size	25%
		150g	7			Packaging / Ethos	21%

Table 5. 33- Conjoint Analysis Results for Organisation N, Healthcare Other (Author)

Total Average Desirability Score of Feature A (Reflex)		Total Average Desirability Score of Feature B (Physio)		Total Average Desirability Score of Feature C (Acupuncture)		Relative Importance of Each Feature Dimension	
Reflexology	10	Treadmill	5	Holistic Acupuncture	6	Reflex	54%
Mobile reflexology	4	Physiotherapy	8	Isolated Acupuncture	7	Physio	31%
		Sport Massage	7			Acupuncture	15%

In each instance these results are in line with company expectations, highlighting the key areas the organisation intends to concentrate on in the future. Interestingly, future emphasis will be based more upon *Skin Care* and *Healthcare Other* in the approach to growth – ignoring *Biomechanics* that provides the highest Conjoint Analysis score.

- **Repertory Grid Analysis results**

Organisation N was able to provide data for use in a Repertory Grid Analysis – the results of which are illustrated in Table 5. 34, Table 5. 35 and Table 5. 36 and align with organisational expectations.

Table 5. 34 - Repertory Grid Analysis Results for Organisation N, Foot Care (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS

Press to Order

	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)** Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Foot functions	1	7	57%	3	5	1	5	22
Foot shape analysis	6	3	57%	3	5	1	5	23
Nail care	4	5	14%	3	5	1	3	21
Advice	2	4	14%	3	5	1	5	20
Corns	3	6	29%	3	5	1	3	21
Callouses	4	4	29%	3	5	1	5	22

Table 5. 35 - Repertory Grid Analysis Results for Organisation N, Skin Care (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS

Press to Order

	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)** Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Oils	1	4	54%	3	5	1	5	19
Scents	7	10	54%	3	5	1	5	31
50g	5	5	25%	3	5	1	3	22
100g	3	8	25%	3	5	1	5	25
150g	4	7	25%	3	5	1	3	23
Recyclable	5	5	21%	3	5	1	5	25
Refillable	2	8	21%	3	5	1	1	20

Table 5. 36- Conjoint Analysis Results for Organisation N, Healthcare Other (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS (Press to Order)	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)**	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Reflexology	1	10	54%	3	5	1	5	25
Mobile reflexology	7	4	54%	3	5	1	5	25
Treadmill	5	5	31%	3	5	1	3	22
Sport massage	3	7	31%	3	5	1	5	24
Physiotherapy	4	8	31%	3	5	1	3	24
Holistic acupuncture	5	6	15%	3	5	1	5	25
Isolated acupuncture	2	7	15%	3	5	1	1	19

In each instance the company owner agreed with the outcomes and supported these results. It was felt that the results for *Skin Care* (Table 5. 35) were possibly the most beneficial to the organisation as this analysis enabled the product to be broken down into more apparent features, thus making future product development more specific and differentiated. Whilst the data outputs from the other products were equally accurate, it was felt that it would be harder to package them together for clients due to their service-based nature.

5.11. Case Study Organisation O

Organisation O is an SME publishing company that has operated for approximately 25 years. Further to a number of events, the company changed its focus approximately a decade ago, transforming itself from one being solely interested in sales to one that is more focused on the customer experience. The company presently has two key publications (and a further two products) and sells approximately 50,000 copies of one of its magazines monthly – the other is in its introductory stage for which sales data was not forthcoming. In addition to hard copies, electronic versions of the magazine are available which are provided free of charge in exchange for customer contact details (for mailing list purposes). This is significant as advertising rates are based upon subscriptions and advertisers are keen to see readership expansion through whichever means possible.

Profits are low based upon unit magazine sales, but are made up from advertising. Whilst a standard advert pricing structure is in place, the owner is keen to support writers and other organisations (particularly non-profit) and will at times provide free advertising.

Supporting the magazines are online televisual-based offerings for subscribers providing interviews, reviews and other relevant information. These are financially supported via advertising and are popular with customers.

- **Market Risk**

The company holds a strong position within the market, and in its field is the second largest publisher of its kind in the world. Despite this position, the owner is conscious of the need to maintain reader interest to remain strong. Such is the product expansion that new publications have been introduced – one operating effectively operating under a franchised name.

Competitors monitor its activities and are aware of the value of its brand. This is expected to continue should expansion be maintained as predicted. The brand name and logo hold trademark status and legal action has been instigated on a number of occasions to protect them.

- **Suppliers and the Supply Chain**

The company has a limited number of suppliers and has historically had poor relationships with them, viewing them as little more than *providers*. Orders have been made as and when needed and no thought was given to long-term supply chain interactions.

- **Relationship with Suppliers**

Whilst the company interacts with suppliers, such relationships have historically been grounded on a needs-basis with neither party being interested in long-term commitments. This was in part due to the nature of the sector and the level of competition faced – by not sharing information there was less chance of industrial espionage.

In more recent years the company has worked more closely with local suppliers to maintain their levels of business and intends to do so in the future. The company is clear about the profit levels suppliers can make and has been keen to ensure this was seen as fair.

- **Suppliers and the Future**

Despite the attempts to work closely with local suppliers, the company may be close to making a significant change to its mode of operations - the impact it would have on at least one supplier would be substantial. A new supplier has become known from Eastern Europe who can undercut the main local supplier by more than 50%. The managing director highlighted two lines of thought

regarding this – the moral and the financial. A final decision on this matter had not been made during the time of the research.

- **Vulnerabilities**

The company considers itself to be highly vulnerable within the marketplace – should customer tastes change the impact would be swiftly felt. It is also potentially vulnerable from competitors - it has reason to believe that one competitor has tried to ensure an employee was hired by *Organisation O*, the owner presuming this to be for industrial espionage reasons.

Whilst the company is now largely self-financing, the owner is aware that market changes would quickly alter this position. Furthermore, the company faces a challenge with regards the people it employs. The owner believes that the company ethos is such that anyone not working to it negatively impacts the product. Consequently, all employees are carefully vetted and monitored.

Investors have approached the company with a view to expansion but in a similar way to the employee challenge, the owner became aware that such expansion would not be in the best interests of the brand and has subsequently avoided this route. The owner's dedication here is such that a substantial offer to purchase the brand outright was recently rejected. Due to the expansion and subsequent extra work involved, a more strategic management approach is being taken for the future.

- **Business Environment**

The company is largely neutral towards the environment in terms of minimising its outputs. Transportation is kept to a minimum and most work is completed online and compiled, edited and sent for printing electronically.

- **Product**

The product is seen to be a key organisational strength. The magazines have 50,000 subscribers who, according to the owner, are keen to adopt new products as the brand expands. Subsequently consideration is being given to branded podcasts, a dedicated YouTube channel and an on-line radio station in a bid to expand further. Despite the brand popularity, the owner is adamant that any expansion is carefully controlled and meets the ethos and quality the brand has come to be known for.

- **Financial Situation**

The company is effectively self-financing and subsequently makes little use of financial loans. The owner is however financially aware having previously worked in the banking sector and feels confident of dealing with such matters should they be required. Issues relating to international exchange rates are not a concern as the physical magazine is only sold within the UK - the virtual magazine is freely available internationally. It is not believed that the economic situation makes any significant impact upon sales, as evidenced from the last economic downturn.

- **Summary Table**

A summary table of findings for Organisation O is presented in Table 5. 37.

Table 5. 37 – Summary of Organisation O Findings (Author)

Organisation O Summary Table	
Level of Competition (Low/Medium/High)	High
Number of Key Competitors	Multiple (1 significant competitor)
Product Complexity (Low/Medium/High)	Medium
Number of Suppliers	12
Number of Customers	50,000
Number of Products Sold	4
Annual Turnover	£900,000
Financial Liability	None
Overall Relationship with Suppliers (Low/Medium/High)	Low
Level of Uncertainty and change within Business Environment (Low/Medium/High)	High

- **PFS Model Results**

The PFS Model results for *Organisation O* are illustrated in Figure 5. 11 and Table 5. 38.

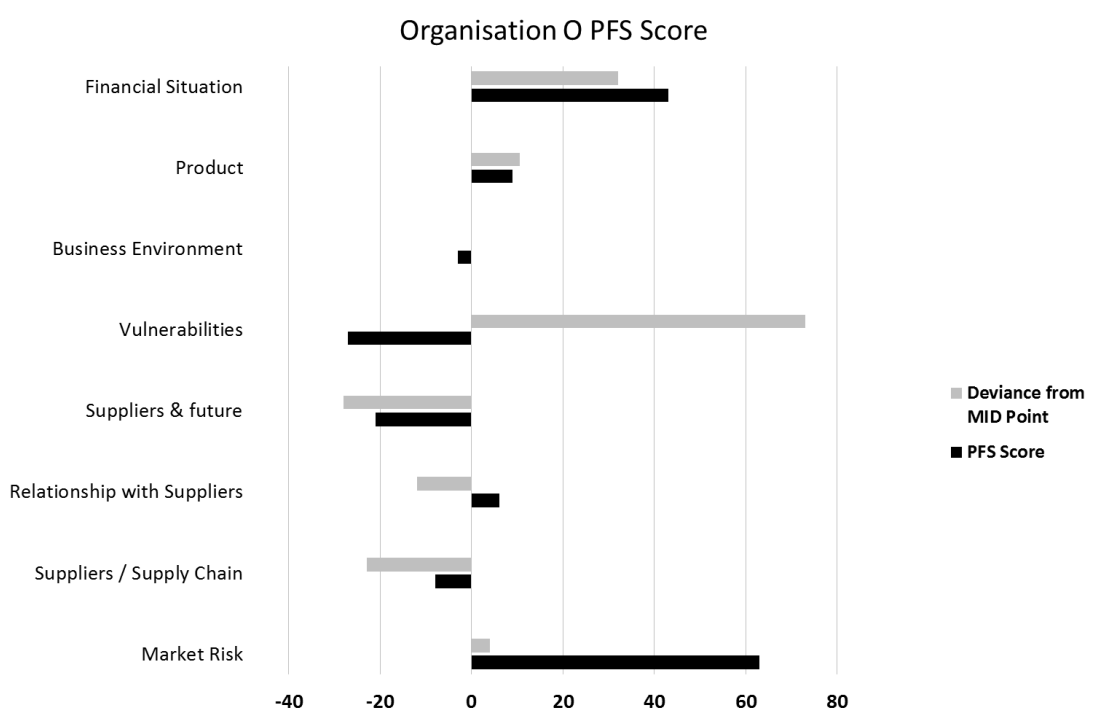


Figure 5. 11 - Organisation O PFS Model Score (Author)

Table 5. 38 - Organisation O PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation O PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	63	7	59	111	107%	4
Suppliers / Supply Chain	-8	-18	15	48	-53%	-23
Relationship with Suppli	6	-14	18	50	33%	-12
Suppliers & future	-21	-106	7	120	-300%	-28
Vulnerabilities	-27	-215	-100	15	27%	73
Business Environment	-3	-18	-3	12	100%	0
Product	9	-120	-1.5	117	-600%	10.5
Financial Situation	43	-31	11	53	391%	32

The PFS Model successfully highlights the standing for *Organisation O*, supporting the views made during the questionnaire-interview. The key point of concern relates to vulnerabilities, suppliers and the future, suppliers and the supply chain and the environment. Whilst other outputs are strong, these supplier-related results indicate areas for consideration – a point accepted by the owner.

- **Conjoint Analysis Results**

Organisation O was able to provide data to run a Conjoint Analysis, the results of which are illustrated in Table 5. 39.

Table 5. 39 - Conjoint Analysis Results for Organisation O (Author)

Total Average Desirability Score of Feature A Content		Total Average Desirability Score of Feature B Adverts		Total Average Desirability Score of Feature C Video		Relative Importance of Each Feature Dimension	
Intrerviews	10	Full Page	13	Talking Interviews	14	Content	78%
Reviews	4	Half Page	12	Days Filming	11	Adverts	9%
Regular Authors	22	Quarter Page	14			Video	13%
Guest Authors	16						

These results are in line with company expectations and highlight the key areas the organisation will be concentrating on in the future.

- **Repertory Grid Analysis results**

Organisation O was able to provide data for use in a Repertory Grid Analysis – the results of which are illustrated in Table 5. 40.

Table 5. 40 - Repertory Grid Analysis Results for Organisation O (Author)

CLICK HERE TO RUN SORT MACRO OF RESULTS Press to Order	Ranking of Capability/Attractiveness to Company	**Market Desirability Score from Conjoint Analysis (Out of 10)**	Relative Importance of Feature Dimension from Conjoint Analysis	**Supplier - E (Exists), D(Does not exist), P (Partner Supplier), k (Do not know)** Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
Reviews	1	4	78%	3	5	5	5	23
Days filming	7	11	13%	3	5	1	5	32
Half page	3	12	9%	3	5	5	5	33
Full page	3	13	9%	3	5	5	5	34
Quarter page	3	14	9%	3	5	5	5	35
Interviews	9	10	78%	3	5	5	5	37
Talking head interviews	7	14	13%	3	5	5	5	39
Guest Authors	6	16	78%	3	5	5	5	40
Regular Authors	1	22	78%	3	5	5	5	41

These results align with organisational expectations, and illustrate the areas the company will be expanding its product offering into within the next twelve months. Feedback not only clarifies these results but has also helped substantiate the company's beliefs in its path to expansion.

5.12. Data Analysis Overview

A summary of the models tested, their outputs (and subsequent alignment with organisational findings and expectations), their practical application within organisations, relevance of outputs and potential interest for the future are illustrated in Table 5. 41. Withdrawn organisations have not been included in this table.

Table 5. 41 – Overview of models tested at each Organisation, their output alignments (with expectations) and potential for implementation (Author)

	Models Tested at Organisation			Models Outputs Align with Organisation Findings?			Models Practically Applied in Organisation?			Outputs Relevant?	Future Interest?
Organisation Reference Name	PFS Model?	Conjoint Analysis	Repertory Grid Analysis	PFS Model	Conjoint Analysis	Repertory Grid Analysis	PFS Model	Conjoint Analysis	Repertory Grid Analysis	Low/ Medium/ High	Low/ Medium/ High
Organisation A	✓	×	×	✓	N/A	N/A	×	N/A	N/A	N/A	N/A
Organisation B	✓	×	×	✓	N/A	N/A	×	N/A	N/A	N/A	N/A
Organisation C	✓	×	×	✓	N/A	N/A	×	N/A	N/A	N/A	N/A
Organisation E	✓	×	×	✓	N/A	N/A	×	N/A	N/A	N/A	N/A
Organisation F	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Low
Organisation G	✓	✓	✓	✓	✓	✓	✓	✓	✓	High	High
Organisation H	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Low
Organisation K	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Medium
Organisation L	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Medium
Organisation N	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Medium
Organisation O	✓	✓	✓	✓	✓	✓	×	×	×	N/A	Low

At this point in the presentation of the research findings, having considered the results for each case study, an overview of the broad outcomes can be considered, identifying any patterns (or otherwise) within the data set. These overviews consider each of the key areas identified in the PFS Model in turn. Analysis of the data is presented in the following chapter.

- **Market Risk**

91% of case study organisations can clearly define their market for each product and 73% are in the growth stage of their product life cycle. Furthermore, 91% of the organisations can clearly define their corporate strategy and 82% can clearly define their marketing strategy for every product being sold. 45% sell on a business to business basis, 27% on a business to customer basis and 9% sell to end users.

In regional terms, 36% of companies operate exclusively on a local basis, 9% on a regional basis, 18% on a national and 18% on international basis. Of all the organisations under consideration, only one considers itself to operate in each field.

Whilst some organisations consider themselves to operate in a niche field with relatively low competition (9%), the majority operate in highly competitive markets (64%). The remaining 27% sit in the medium category for competitiveness.

The sizes of potential markets for the organisations under consideration align to these figures to a large extent with 64% believing their market to be large. 18% of respondents believe their markets to be small or medium sized respectively. The attractiveness to the overall market partially aligns with this data in as much as 64% of responding companies believe the market to be highly attractive, 27% believe it to be of medium attractiveness and 9% to be low. The profitability of the potential market does not align to this information though. 55% of participating organisations believe the potential market to be of medium profitability, 27% believe it to be high and 18% believe it to be low.

As part of the data gathering process for the PFS Model, the questionnaire-interviews identified barriers that organisations believe will affect their growth over the next five years. These are illustrated in Figure 5. 12 and Figure 5. 13 to illustrate their significance as part of the overall model.

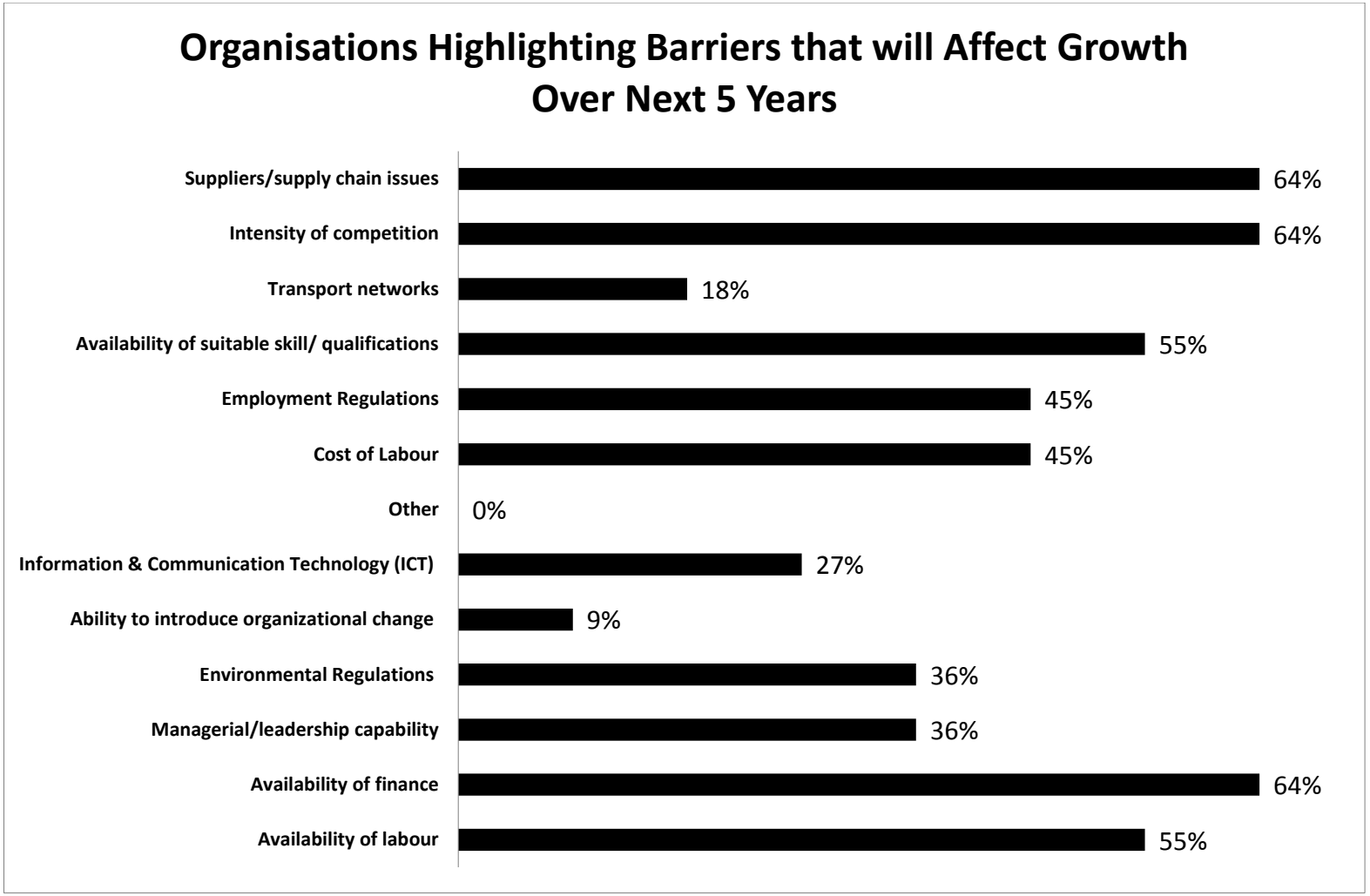


Figure 5. 12 – Barriers that will Affect Growth Over the Next 5 Years (Author)

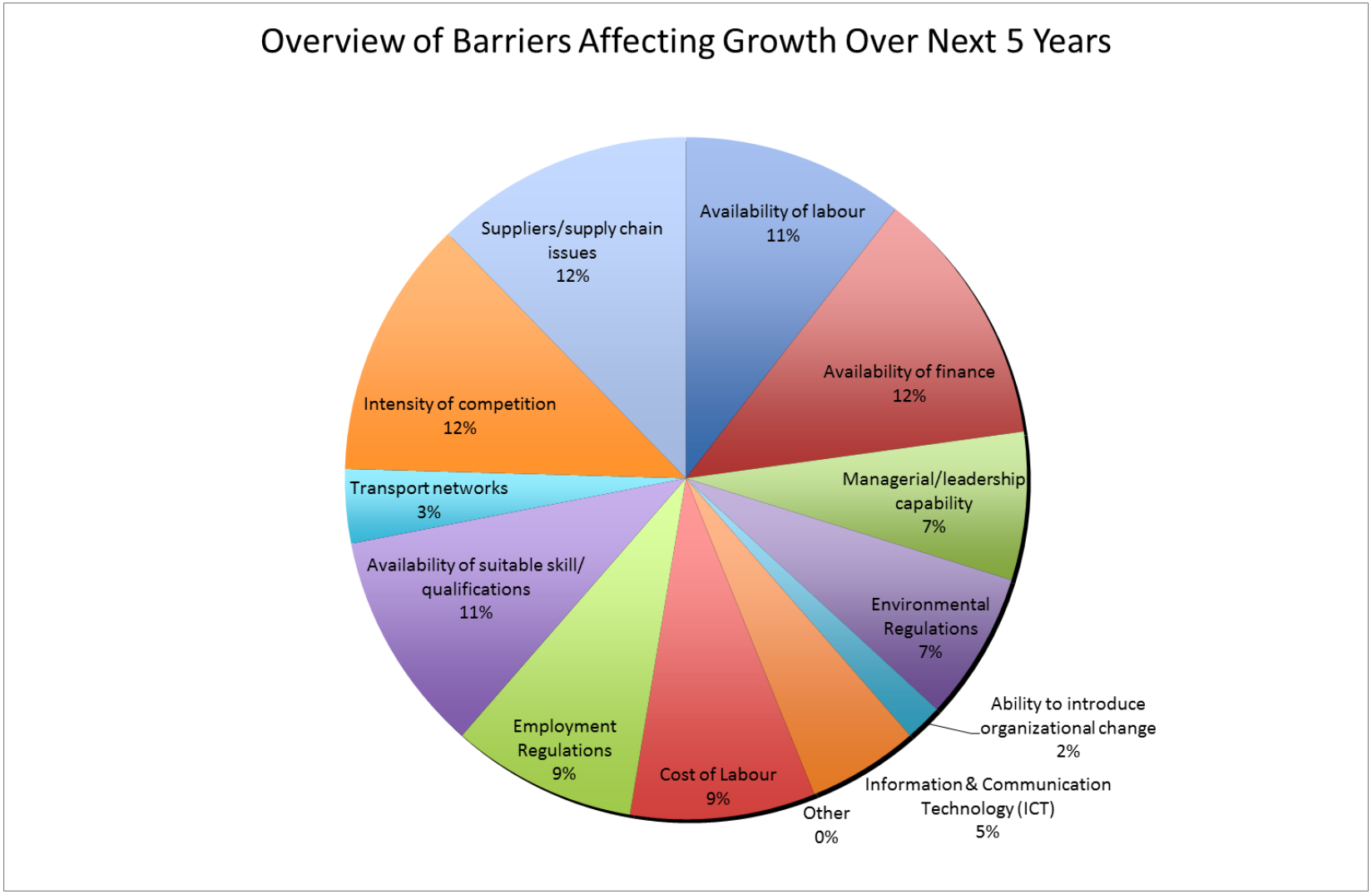


Figure 5. 13 – Percentage Overview of Barriers that will Affect Growth Over the Next 5 Years (Author)

- **Suppliers and the Supply Chain**

Whilst suppliers and supply chain issues, the availability of finance and the intensity of competition provide the highest potential barriers to affect growth in the next five years, 45% of responding organisations believe their relationship with suppliers to be very good, 9% to be poor and the remaining 36% sit between the two. When issues arise with suppliers, 64% of respondents do not believe them to arise exclusively from the same supplier.

Still considering this point regarding future growth, it is interesting to note that no supplier is aware of corporate or marketing strategies for any of the responding organisations, yet 73% of these SMEs felt such information and knowledge would benefit their organisations and 64% of respondents felt that such knowledge would assist in the development of their products and services.

It could be argued that these issues may in part be attributable to the fact that 64% of respondents choose to make individual orders rather than work with suppliers under contract. Such methods of operation clearly suit some of the case study companies but for others the individualistic nature of the relationship might explain the fact that 63% of respondents have low levels of trust with their suppliers (yet 64% are heavily dependent upon them). Further to this, 63% of case study organisations suggest they enjoy low levels of commitment from their suppliers yet paradoxically 82% of respondents acknowledge suppliers share information with them and just over half of the sample acknowledges suppliers actively communicate with them (with 72% acknowledging that suppliers provide good levels of cost transparency). Furthermore and from a positive standpoint with regards supplier involvement, 64% of organisations believe suppliers would respond favourably to close working relationships and 55% have incorporated supplier involvement into the design of products and production processes.

Just over half the case study organisations acknowledge the benefits of working with suppliers in introducing new technology and knowledge (a similar number believe suppliers have assisted in developing new product ranges, quality and delivery), yet 64% believe suppliers have had no effect in opening up new markets for them. Somewhat paradoxically, 64% of respondents believe suppliers to have helped open up new product ranges. It might be argued here that suppliers are willing to help develop new products as it results in sales. Their lack of market and direct customer knowledge frustrates the situation thereafter though, potentially indicating that more open lines of communication and information sharing might help to overcome this, thus assisting in developing their agile supply chains.

In terms of supplier selection, organisations agree that cost, quality, and the ability to deliver to be the key factors with proximity and relationships to be lower down the ranking.

- **Suppliers and the Future**

An important element of agile supply chains is the development of relationships between the organisations involved. 82% of respondents believe that the supply chain as a whole could act as a vehicle for future developments, and just over half of them have developed relationships with this view in mind, with 64% reporting that this has assisted the organisation in product development (Product development improvements coming from efficiency (73%), design (64%), production (55%), research (45%, quality (55%), delivery (64%), cost reduction (36%), efficiency 73%, profitability (64%)). Yet despite these statistics, 55% of organisations do not believe their suppliers to be aware of the impact upcoming technologies could have on their future products and only 36% believe suppliers to be actively incorporating upcoming technologies into their own merchandise. Furthermore, whilst 64% of suppliers are aware of customer needs, 64% of suppliers fail to consistently meet quality requirements – arguably attaching little significance to consumer needs.

All case study organisations believe that if they were to select new suppliers, quality, delivery and cost would be the most important factors to consider, followed by cooperation and partnerships (91%), flexibility (82%), technical support (82%), trustworthiness (82%), cost transparency (64%), being complimentary to the businesses capability (55%), willingness to share risk (45%), technology transfer (36%), providing consultation (36%), and early involvement in the product design (18%). Just over half of all responding organisations believe that strong relationships could assist and shape growth in the future and open up markets. To achieve this, 91% of organisations believe that open and effective communications are required. A similar 91% believe trust to be important and 82% highlight the significance of supplier commitment. Process integration was considered to be of less significance (36%).

The supply chain as a whole could assist and benefit in the future with the knowledge that 55% of respondents indicated that supply chain issues were responsible for missed market opportunities due to the lack of suitable suppliers. Furthermore, 73% felt they were uncompetitive due to material prices and supporting this, 73% of respondents feel their ability to expand is hindered due to a lack of supplier cooperation. If such levels of opportunity are being lost, the supply chain as a whole is losing out, and arguably only supply chain integration and improved levels of communication are likely to start to improve such matters.

- **Vulnerabilities**

73% of organisations partaking in the study believe themselves to be strategically vulnerable. A similar 73% believe themselves to be vulnerable due to societal trends and slightly fewer (64%) feel that social issues could provide some level of vulnerability to their future.

Technical vulnerabilities varied widely amongst participating organisations – arguably due to the different products and markets in which they interact. The most significant points arising from this data indicate that personnel loss and legal issues, followed by IT and then demand shifts are the most prominent areas of concern for the SMEs under consideration. These are illustrated in

Figure 5. 14.

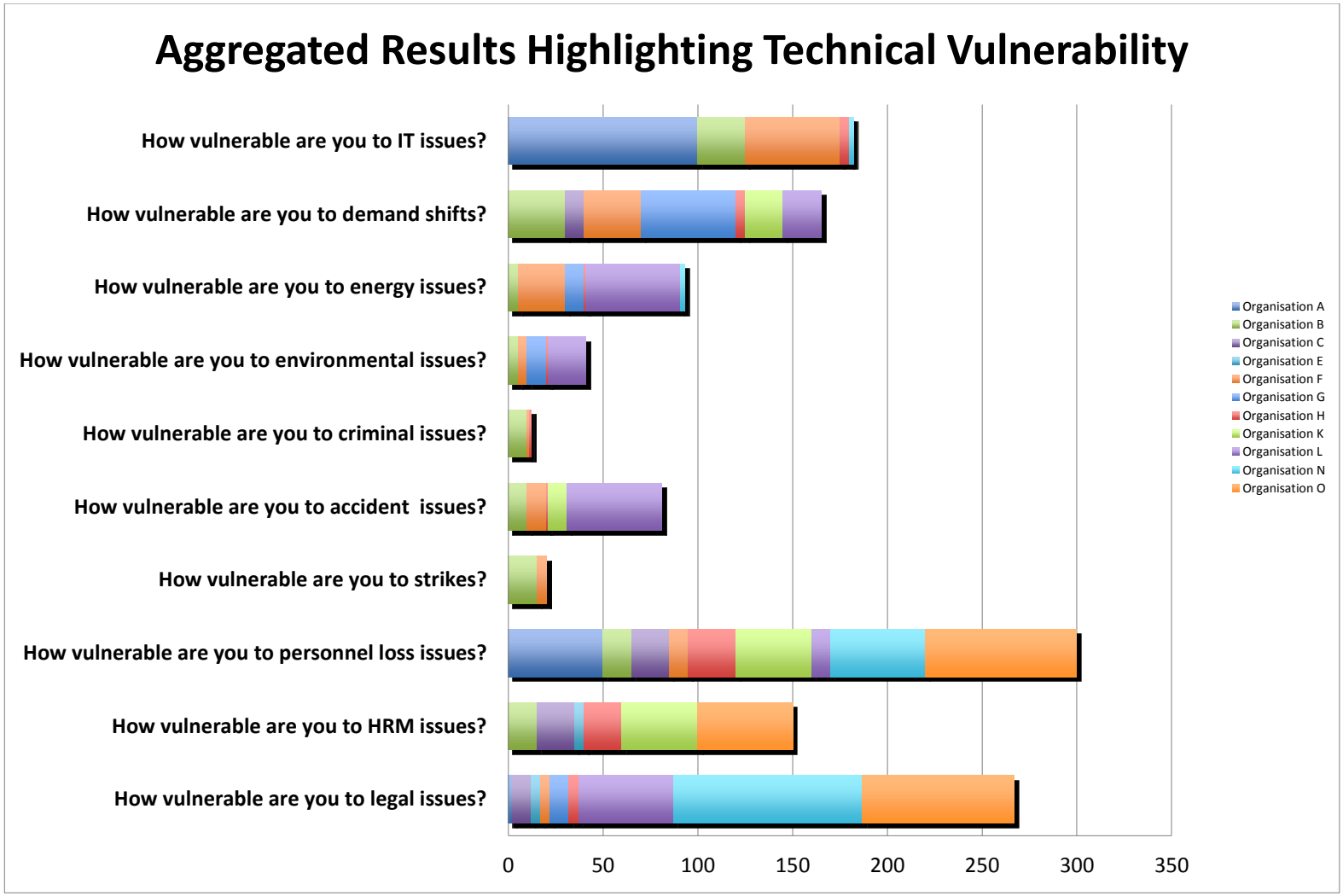


Figure 5. 14 - Aggregated Results Indicating Technical Vulnerability for Data Set (Author)

Similarly, Figure 5. 15 illustrates the aggregated results relating to exposure vulnerability for these organisations, the most significant points highlighting market competition and various market trends as being the key areas the supply chain should be considering.

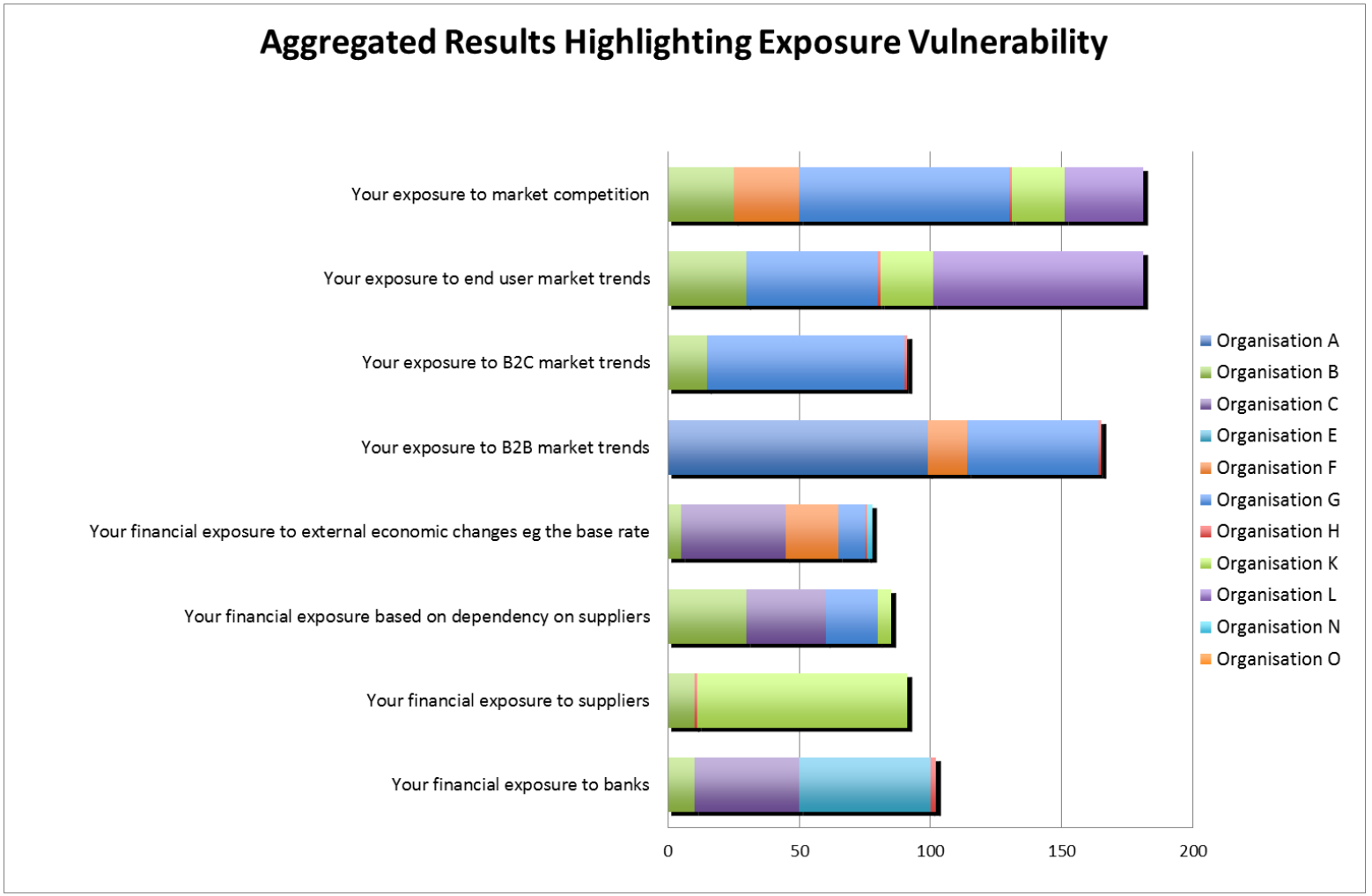


Figure 5. 15 - Aggregated Results Highlighting Exposure Vulnerability (Author)

- **Product**

Figure 5. 16 illustrates the aggregated results of organisational belief factors affecting product success. Whilst most factors are important, significantly for agile supply chains, management, quality and innovation feature highly in organisational requirements.

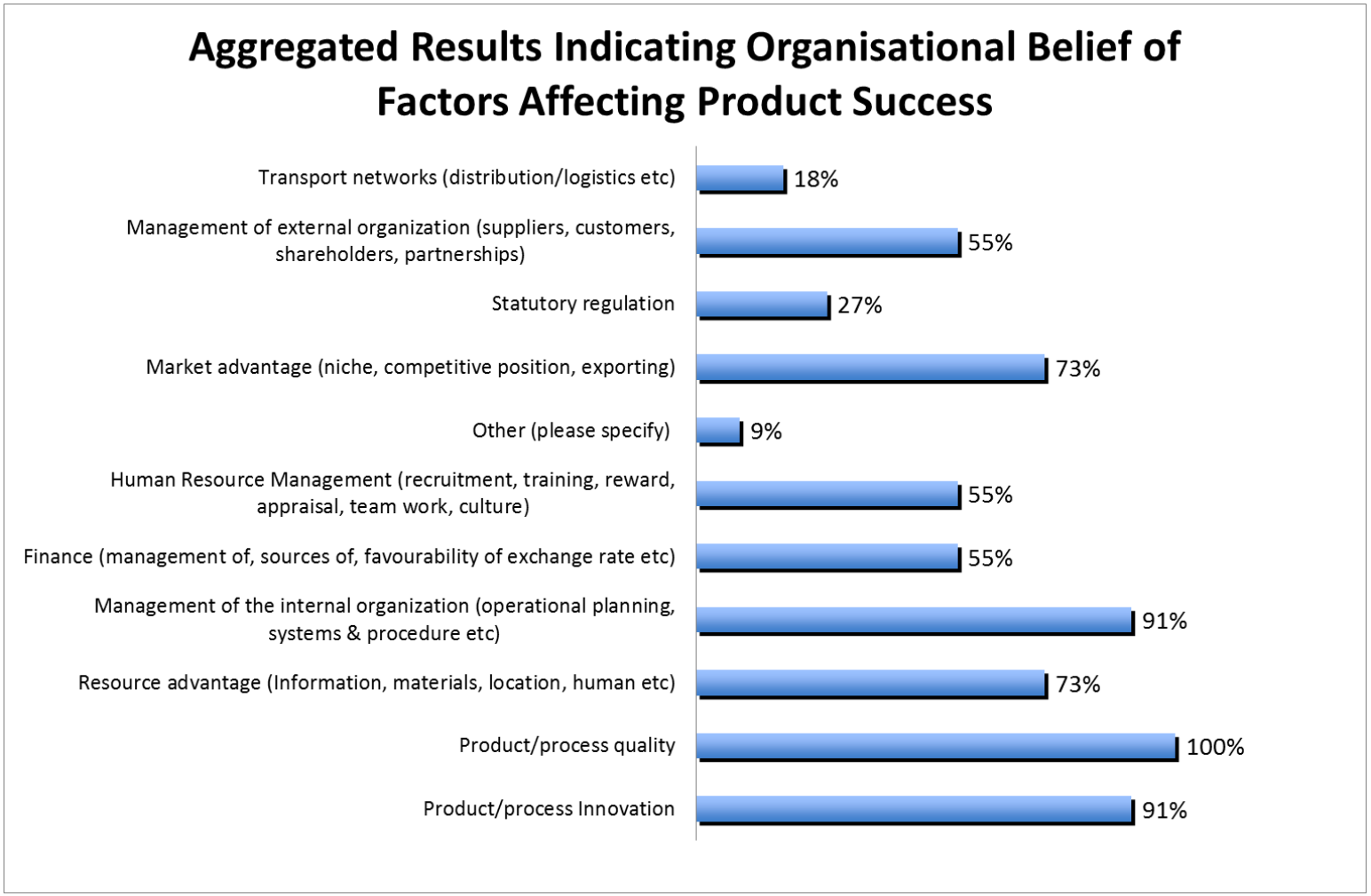


Figure 5. 16 – Aggregated Results Indicating Organisational Belief of Factors Affecting Product Success (Author)

Product development drivers vary with 55% of organisations believing themselves to be first to market with products and leaders in this area. Furthermore, 45% of organisations consider themselves to be reactionary to competitors at times and 82% believe that they develop at least some products as a result of customer requirements. Alongside this data, 91% of the companies are working to introduce new customers to new products and this is unlikely to change in the future.

In the process of developing new products, 64% of respondents utilise the same processes and machinery that have been used before. 45% of respondents require new machinery that is specifically created for the new products.

When considering employee skill levels, 64% of responding organisations believe they already hold the relevant levels of skill. 18% will provide general skill training to develop new products and 27% will provide specific training for new products.

82% of respondents design all their products in-house. 27% of them make use of specialist parts designed by suppliers to their needs, and only 9% buy specialist parts designed between themselves and their suppliers. Only 9% incorporate new features into products based upon new supplier products not specified by the company. 64% believe their product design process to be well managed and 27% believe they need a far more structured process in product design. In addition to this, 55% of organisations make all elements of the product in-house, 55% outsource the manufacture of some parts and 9% outsource all part manufacture.

From the perspective of capabilities and success, organisations highlighted product design (82%), management (82%), research development (73%) and production processes (45%) to be significant and to have affected the success of the product. Conversely, 45% of organisations believe that supply chain management provides the most significant barrier to success, and is followed by human resource management (36%), market research (36%) and production operations at 27%. Furthermore, only 45% of participating SMEs believe that the supply chain has assisted in the success of their products. This indicates that whilst the supply chain is of great importance as highlighted in previous data, it has not been particularly significant in assisting the development of these new products and features.

- **Financial Situation**

Figure 5. 17 illustrates the significance of economic considerations to participating SMEs via aggregated results.

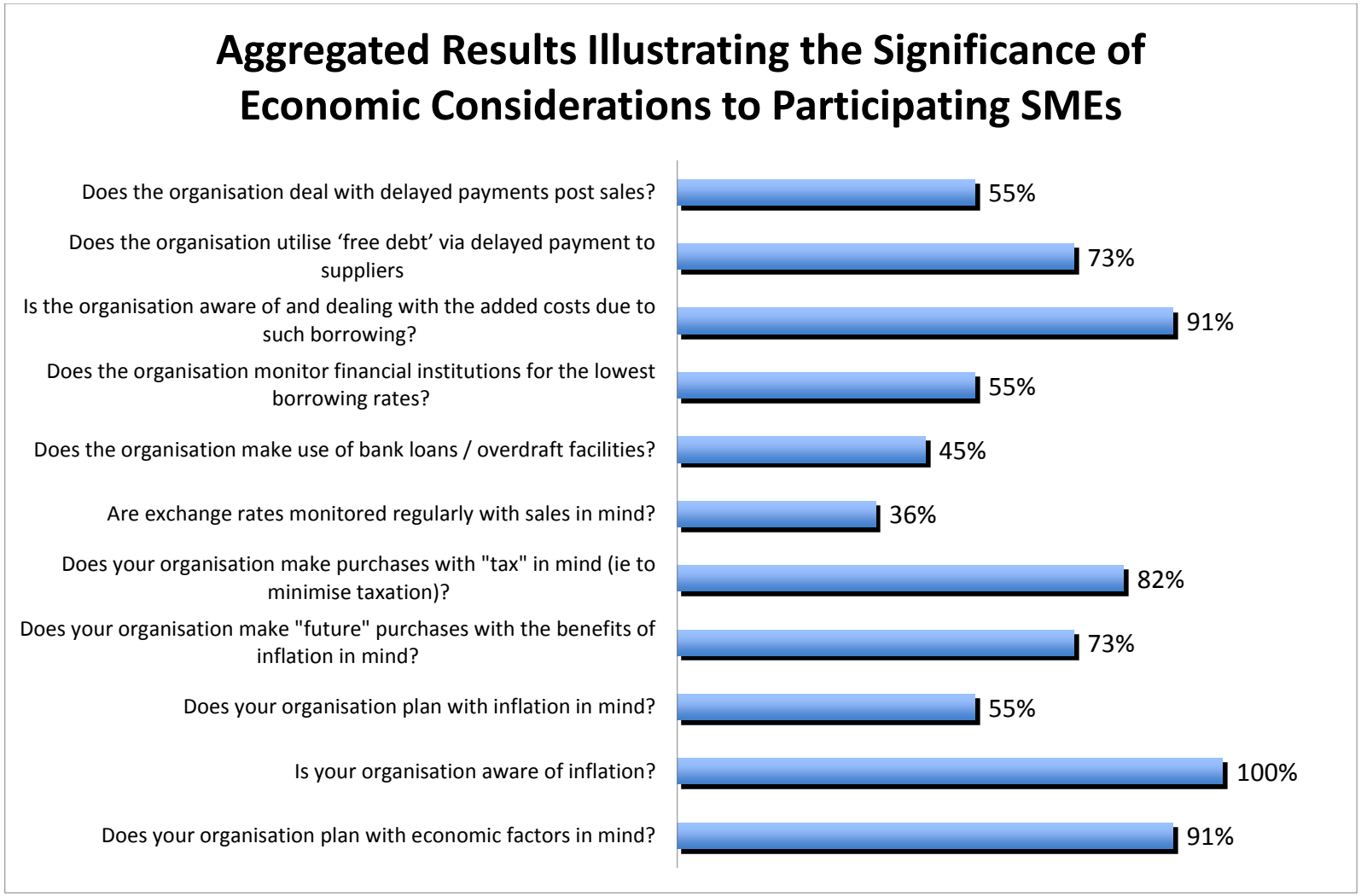


Figure 5. 17 – Aggregated Results Illustrating the Significance of Economic Considerations to Participating SMEs (Author)

Some economic areas are of little concern to SMEs (an example being exchange rates for SMEs that have no direct involvement with international purchases), but most have some bearing on their operations. A point of interest comes from organisational awareness of inflation. Whilst all organisations are aware of it and most (91%) claim to operate with such factors in mind, some questions might be raised as to how organisations holding (or failing to purchase large enough quantities of) stock for significant periods of time are in effect failing to adopt an approach to inflation.

6.0 Discussion

This chapter presents a collated and collective discussion of the outputs from the field study and data reported in Chapter 5. Discussions are directed towards analysing the learning and understanding of the issues addressed in the research in line with the theoretical concepts, ideas and propositions targeted in the literature review and theoretical framework chapters to support or otherwise the models under consideration. While the main focus of the data collection has been the examination of the proposed framework and tools in this research, the research process and methods used (the case studies and interviews) allowed further insights into areas of concern and the companies studied. Qualitative information collected from the interviews and cases allowed for further projection of characteristics such as attitude and perceptions of the firms in relation to the key elements of the conceptual model and agile supply chains.

The theoretical exploration of agile supply chains in the context of SMEs led to the rational conclusion that survival and sustained success in business now requires agile responses from supply chains to benefit all organisations involved therein. Issues such as the need to meet the needs of organisations facing internal and external supply chain risks (Singh *et al.,* 2011), overcoming issues stemming from inefficient and ineffective supply chains (Hingley *et al.,* 2015), the consequential need to improve relationships (Chandra and Grabis, 2007), and the important role of knowledge sharing and cooperation between supply chain members, particularly as uncertainty levels rise (Jain *et al.,* 2008; Pilbeam *et al.,* 2012) were highlighted.

Through revisiting some of the key models and frameworks in the field of study (the Agility Road Map (Ismail *et al.,* 2006), the Framework for Agile Supply Chains (Ismail and Sharifi, 2006), the Strategic Agility Framework (Ismail *et al.,* 2011) and the Extended Ansoff Matrix (Sharifi *et al.,* 2006; Sharifi *et al.,* 2013)) a collective and practical framework (PFS Model) was developed supported by two key supplementary assessment tools (the Conjoint and Repertory Grid Analyses models), as explained in Chapter 3. In particular, the development of the framework was undertaken with two key considerations: (1) the need for an operational method and (2) the need to address the requirements and circumstances of SMEs.

In the following sections, results are discussed from both the data presented in Chapter 5, and also from the findings that emerged as part of the research from comments, observations and documents from the case companies. In the discussion, some key areas will be considered as follows:

- Approach to agile supply chains and their implementation - findings relating to *Objective 1* (To theoretically and empirically explore the idea of agile supply chains in the context of SMEs. This will involve the exploration and extension of agile supply chain frameworks for SMEs, to examine their benefits or otherwise, and to ultimately test them through case studies).
- Agile supply chains and the PFS Model
- Product features - their importance, SME approaches to them and their management across the supply chain
- Supplier management - SME operations, similarities and differences between SME approaches, the importance of supplier management to growth and the learning derived from the data.

6.1 Approach to Agile Supply Chains and their Implementation

The Literature Review identified published concerns regarding agility and agile supply chains, and led to discussions around agility frameworks assisting agile supply chain implementation. This study extracted a number of key factors from these works and tested them through business case studies. Factors such as markets, supply chains and relationships with suppliers, the business environment and organisational vulnerabilities as well as economics of the firms and their products were examined in this process. These factors further aligned to the Four Dimensional Factors of Attractiveness (Sharifi *et al.,* 2009).

As well as the quantitative (PFS Model based) data, the questionnaire-interviews provided qualitative data, alongside which exists the opportunity for further analysis. While the main purpose of the study was to examine the application of the proposed model and tools, the information collected added insight to the research by enabling an analysis of these emerging outputs. In particular, three thematic observations were captured using the notes and comments from the interviews that relate to issues acting as either enablers or barriers to the firms becoming more agile, supply chain (supplier, customer and operational) adaptability to change and dynamics in their markets, and finally, organisational attitudes towards business opportunities.

To begin expanding on these issues, a summary of general data from the firms studied is presented in Table 6. 1, showing the organisations in terms of their size, production format and strategy, market size, and the market uncertainty (for their products).

Table 6. 1 – Case Study Organisations Capacity Categorisation following Questionnaire-Interview (Author)

Case Study / Organisation	Size	Product format/strategy	Market size	Market uncertainty
A	Small	Specialist	Medium	Medium
B	Large	Specialist	Medium	Low
C	Small	Bespoke	Small	Low
E	Medium	Specialist Mass	Large	Medium
F	Large	Mass	Large	Low
G	Small	Bespoke	Medium	Medium
H	Large	Mass	Large	Low
K	Small	Bespoke	Small	High
L	Small	Bespoke	Small	High
N	Small	Bespoke	Small	High
O	Small	Specialist	Medium	Medium

Based upon the data in Table 6. 1, Figure 6. 1 illustrates that the majority of companies operate on a bespoke production strategy, which happen to be of small or medium size.

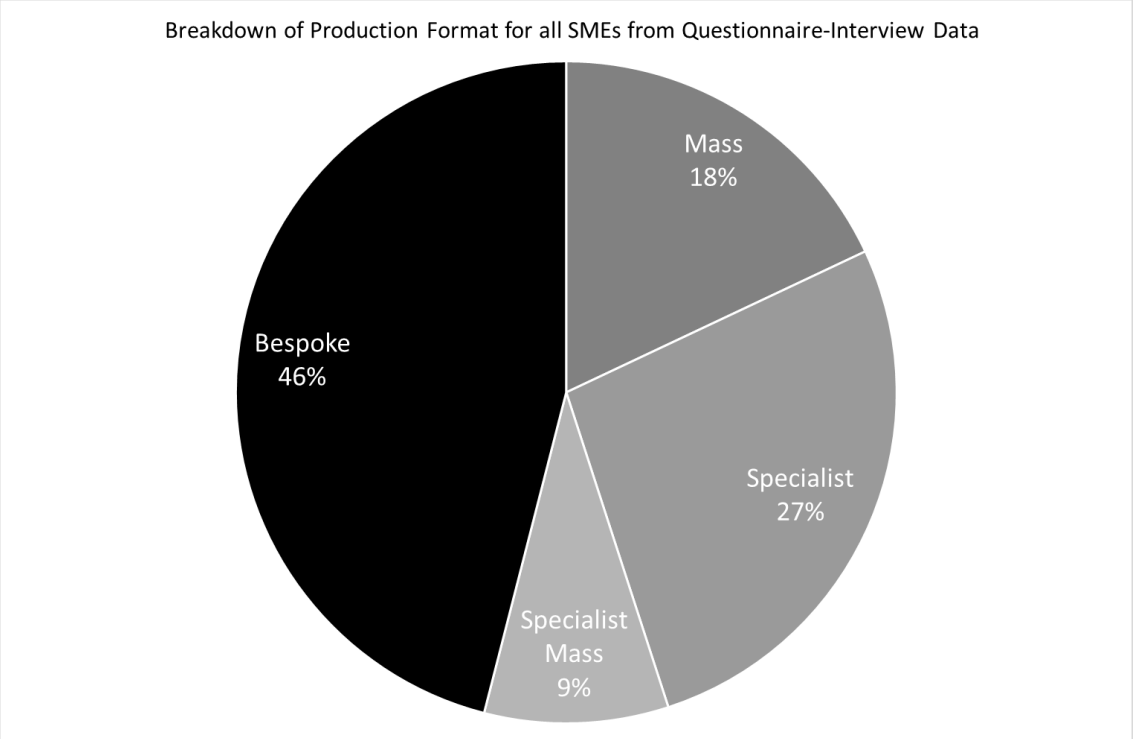


Figure 6. 1 – Breakdown of Production Format of all SMEs from Questionnaire Interview Data (Author)

These findings indicate that the organisations with bespoke production formats are the smaller companies partaking in this study, and are generally flexible with regards manufacture and meeting customer needs. By comparison the *mass production* based companies serve larger markets and have substantially higher turnovers yet are less flexible and require long periods of planning prior to implementing change.

Some examples can be considered here as a means of comparison. *Organisation F* intends to introduce personalisation options for certain products. The options available will be largely cosmetic and supplementary to the basic product rather than being totally bespoke models meeting individual specifications. This requires considerable time and financial investment given the statutory regulations that must align with development and tooling needs. By comparison, *Organisation G* is set up to incorporate similar levels of personalisation into its products on a daily basis and will extend this service as long as the customer is willing to pay. *Organisations C* and *L* operate in similar ways. To an extent the different operating scales, legal requirements, investments and the nature of the products under consideration make this possible, yet patterns emerge indicating that it is easier for the smaller organisations operating on a bespoke basis in smaller markets to flexibly manage their means of production.

As a general observation, it appears that homogeneity exists among the companies holding the same production characteristics in terms of operating in proportionally similar sized markets, under similar operating and market uncertainty conditions, and more importantly presenting similar attitudes towards issues of concern.

- **Issues acting as either enablers or barriers to becoming agile**

When considering *enablers,* it can be deduced that as all participating SMEs are profitable, they are well managed. This broad *enabler* of management can be considered in different ways though - *marketing* for example differs between the different organisations, with the smaller companies relying more on the enablers of social media, contacts and word of mouth than their larger counterparts.

With the possible exception of Organisations F and H, all SMEs in the dataset illustrated issues and barriers regarding the management of their IT infrastructures (Figure 5. 13, page 200;

Figure 5. 14, page 204). This ranged from Organisation C without any such infrastructure to Organisation B whose online presence supports a large proportion of the company's turnover. Despite this, the Operations Manager admitted that the IT system is out-dated and the support staff unwilling to invest effort into it, resulting in the need for external expert assistance to modernise it. By comparison the smaller SMEs are more proactive in terms of managing their IT systems. The owner of Organisation G is "learning as I go" in a similar way to the owner of Organisation O, who is studying to bring social media and online presence up to date.

The most significant issue facing all SMEs herein regarding enablers and barriers aligns to their dealing with suppliers (Figure 5. 13, page 200). The issue is not one of simply failing to obtain supplies when they require them. The point most expressly emerging is that none of them have *control* over the supplier situation. Even the largest companies complained at not being able to guarantee the quality or reliability of parts when they wanted them. This suggests that supply chain management is a broadly accepted on-going concern.

Furthermore, with supplier and supply chain issues being a significant factor in potentially affecting growth over the next five years, it is somewhat surprising to discover that 64% of companies hold regular face-to-face meetings with suppliers and 55% receive regular information updates (73% believing this information to be easy to interpret yet only 36% of respondents believe it to be shared throughout the supply chain). Such data prompts questions regarding the effectiveness and relevance of the meetings held and data received and might suggest that given the relationships already exist, more might be done to align the associated organisations for agile supply chain improvement.

Developing this line of discussion further, it is notable that whilst the majority of respondents believe the supply chain could act as a vehicle for future developments, just over half have developed relationships with this in mind, and a similar number believe their suppliers to be unaware of the impacts they have on product development. Similar data is presented in terms of suppliers being aware of customer needs yet failing to deliver to the expected standards. If new suppliers were to be found, such issues would be significantly important to these SMEs yet this knowledge is either unknown or not acted upon, thus having a detrimental affect on the supply chain as a whole. This information indicates a series of supply chains that are misaligned, yet it also provides the opportunity for change – awareness of such points can be used as the starting point for re-alignment. Such changes could help to stabilise highlighted issues relating to market competition, exposure to market trends, business-to-business interactions and factors such as exposure to suppliers (in line with Smets *et al.,* 2013), and could further integrate the supply chain design (in line with Florian, 2013) such that when customer demands change, the product can be differentiated and altered in line with their needs (in line with Constangioara, 2014, Tsinopoulos and Mena, 2015).

Beyond supplier relationship focused issues, the majority of respondents believe their organisations to be vulnerable, the most significant findings being personnel loss, legal issues, IT and demand and market shifts (

Figure 5. 14, page 204). Personnel and IT issues can be considered from an internal management perspective. Legal issues can be potentially minimised by adherence to product quality (thereby requiring benefits that could be brought about by an agile supply chain). Similarly, product quality assurance improvements can help to manage demand and market shifts which again can be brought about in part by agile supply chain development.

In terms of the product, significant emphasis is placed upon design, development and production yet just under half of the respondents believe supply chain management to be a significant barrier to success. This is significant as it illustrates the lack of agility within these supply chains. Developing agility into these supply chains could provide the ability to meet shifting customer demands through faster product design, manufacture and lower cost distribution (in line with Hasani *et al.,* 2012)

- **Adaptability to change (in line with product needs)**

An aspect emerging from the examination of organisational situations relates to the dynamics in their product market, and their adaptability to customers' changing needs. The evidence shows that whilst the smaller organisations operating under *bespoke* production formats are driven to quickly adapt product features to meet market needs, organisations operating on *specialist* and *mass* production formats appear to be inclined to change less quickly (*Organisation A* is an exception to this, with evidence suggesting the company does respond urgently to customer needs, dismantling finished products to provide parts when necessary).

A quote from *Organisation G*'s owner stated "I'll listen and try anything once if I think there's a market for it…we can stop if it doesn't work," suggesting the attitude and ability of the bespoke approach indicates the swift response the company has to the need for a product. Similarly, *Organisation K*'s owner stated, "we change depending on what the person in front of us needs." Such quotes contrast significantly with *Organisation B*'s Operations Manager who affirmed, 'Well from its announcement to its delivery here to selling out, the life-cycle is over four years."

In summary, the urgency of product development appears to be relative to the size of the company, market and attitude, with the smaller companies being quicker at adapting products and features to the needs of customers.

- **Attitude Issues**

The results relating to the attitude towards market opportunities show that organisations operating on a *bespoke* production basis present a more positive approach towards market opportunities, while the *specialist* production group has a more indifferent stance in this regard. For instance, *Organisation B's* Operations Manager, representing one of the largest companies in the sample, demonstrates a relaxed approach to customers in the statement, "Customers have got an appetite to buy. The stereotype says that it's women who are looking for therapeutic retail therapy. Well I don't believe it. I think it applies to men as well. I think guys come in here to try to buy something because they enjoy the sense of going home with something in a carrier bag or they like getting a parcel through the post." *Organisation B*'s attitude may be the result of operating a long-established business in a well-established market, providing reliable and historical evidence of relatively stable product demand.

Smaller businesses are not afforded the same level of demand assurance and by comparison, as the owner of *Organisation K* stated, "It's just about what the person in front of us needs." Alongside this the owner of *Organisation L* stated, "I have to give the customer what they want when they need it – they

can always go somewhere else." The owner of *Organisation G* testified, "We do what the customer wants – we give advice but if they don't want to follow it then we do what they want – they're paying." The differences in approach to customers is quite distinct here – the larger organisations work from the basis that customers will continue buying their products whereas the smaller companies operating on a bespoke basis do not appear to take customers for granted in the same way.

- **Attitude to Suppliers**

The *attitude* factor is significant when dealing with suppliers. The smaller organisations (*A, C, G, K, L* and *N*) tend to operate without contractual supplier agreements and purchase on a needs basis. Despite this, they appear to accept the situation for what it is and appear to be adaptable when dealing with suppliers. This is illustrated in a quote from the owner of *Organisation N* who stated, "I get on the phone and negotiate with my supplier. I know what I want to pay. If they won't budge then I offer to buy something else that I'll need soon and see what offer comes with the bigger order." *Organisation C*'s owner stated similarly, "If my usual supplier hasn't got what I want I ring around to find someone else that has got it in."

By contrast the larger organisations benefit from the ability to work with suppliers on a contractual basis as evidenced by the Operations Manager at *Organisation F* who stated, "There are contracts of 1 to 3 years…we generally try to fix them in a financial year."

- **Attitude to Customers**

Whilst on the surface of it all organisations in the study are concerned with customer satisfaction, knowledge of customers is not always clear. An example of this is illustrated when the director of *Organisation E* was asked how many customers the company has, the response being "Probably around about...I'm uncertain at the moment - I don't know." To the same question the owner of *Organisation C* replied "Over the last three years? I don't know." Along similar lines and indicating not only an attitudinal approach but a failure to provide direct answers, the two owners of *Organisation A* were asked about their approach to attracting customers via new products. Their responses were:

> Interviewee 1: "I mean we've always got new products coming or we're reinventing products that are always there, but..."
>
> Interviewee 2: "We try to get new customers for new products, but we also try to get the old customers interested."

> Interviewee 1: "We find that our customers buy…we're always reinventing products so therefore the customers we had 10 years ago have bought two, three, four of our products over the years."

By comparison, the owner of *Organisation L* not only keeps records of each customer order but also maintains a photographic database of previous orders as a means of tracking likes and dislikes. Further correspondence is maintained with customers via text to ensure the goods meet all requirements. Along similar lines, the owner of *Organisation N* invests in new equipment (some of it expensive) to meet client needs as and when they occur and *Organisation G* provided evidence to illustrate the extreme lengths it travels to do similar.

Whilst there is no clear categorisation between these companies in their approach to customers, those organisations operating on a *bespoke* manufacturing basis tend to provide the most customer-focused approach to their business.

- **Summary of learning from case studies**

The outcomes from this dataset illustrate that companies operating on a *bespoke* basis are the most flexible, adaptable and positive with respect to suppliers, customers and stock control. They also tend to be the smallest companies operating in the smallest markets. The *specialist* organisations are the second in the dataset followed by the *mass-production* based organisations.

From this perspective, the smaller companies are therefore the most agile – a point supporting the argument by Gunasekaran (2011) that smaller firms have the characteristics for being quick and flexible and hence might be strategically able to adopt agility and capitalize on building agile supply chains. This argument also aligns with Ismail *et al*., (2011) for agility being a logical means through which to help SMEs compete in the future. Their lack of resources are possibly an operational hindrance yet are also the driving force behind their adaptability, success and ability to survive. Whilst accepting that larger organisations have the financial power to maintain market presence, based upon the outcomes from this dataset it is the smaller companies that have the motivational, adaptable and attitudinal approaches to align most closely with market needs whilst doing their best to affiliate their working patterns with the supply chain. At the same time, the smaller SMEs are best at aligning their operations to the external, insecure environment, thus improving their operational methods (in line with Hallavo, 2015) and required market standards (Nickell *et al.,* 2001).

At this stage therefore, agility is not the reserve of large, financially powerful companies. Its development is arguably equally if not better suited to smaller SMEs who naturally adapt to markets and

opportunities as they arise. The outlook for these SMEs is therefore arguably positive. The challenge they face (particularly the smaller SMEs) is one of sustainability and growth when competing with larger companies.

It was argued in the Literature Review that the way forward in managing exposure and insecurities (Christopher and Holweg, 2011) is through agility (Christopher, 2000) and agile supply chains (Chandra and Grabis, 2007). To capitalise on their strengths and manage these factors, SMEs need to understand their present operational standing whilst aligning products and features to suitable supply chain partners to become agile – something that does not appear to have been done in these case studies, and arguably something SMEs are largely unaware of and unable to achieve at the present time.

Despite the presence of the frameworks previously considered to develop agile supply chains, their strategic stance and unsuitability renders them ineffectual for SMEs. By comparison, the PFS Model supported by the Conjoint and Repertory Grid Analyses provides a suitable means to overcome such obstacles and progress SMEs (particularly smaller ones) towards developing agile supply chains. It is effectively their point of initiation for agile supply chain development.

6.2 Agile Supply Chains and the PFS Model

The PFS Model has been designed to bridge the gap between the agile supply chain development frameworks and the operational requirements to develop them, effectively identifying an SME's present operational standing relative to the agility goal, the design of which was based around key references considered in the Literature Review and Theoretical Framework chapters:

- The Agility Road Map (Ismail *et al.,* 2006)
- The Framework for Agile Supply Chains (Ismail and Sharifi, 2006)
- The Strategic Agility Framework (Ismail *et al.,* 2011)
- The Extended Ansoff Matrix (Sharifi *et al.,* 2006; Sharifi *et al.,* 2013)

To assist in the discussion, key agility-related references considered in the Literature Review have been cross-referenced against these framework models to focus on how they have been addressed. This is illustrated in Table 6. 2 and is continued in Table 6. 3 (page 224) and Table 6. 4 (page 225).

Further to these cross-references, a similar analysis has been conducted to illustrate how the PFS Model addresses the same key points. This is illustrated in Table 6. 5 (page 226) and continued in Table 6. 6 (page 227) and Table 6. 7 (page 228).

Table 6. 2 – Key Areas within the Literature Review and their Coverage/Interactions with the Framework Models Considered in the Theoretical Framework Chapter (Author)

	Management of international production, increased competition, unstable markets and buyer tastes (Gunasekaran and Ngai, 2005; Cabral et al., 2012)	Obstructions and inefficiencies (Hendricks and Singhal, 2005)	Need to be reactive (Lancioni, 2000)	Levels of flexibility and innovativeness (Prastacos et al., 2002; Bishwas, 2015)	Internal & external supply chain interference (Singh et al., 2011)	Demand unpredictability (Christopher & Holweg, 2011)	Change (Asmussen & Waehrens, 2015)	Supply chains become intertwined information management systems (purchasing, manufacture, warehousing) (Sukwadi et al., 2013)	Balancing risk & suppliers against stakeholders (Borjeson et al., 2015)
Agility Road Map (Ismail *et al.,* 2006) Plans & tools for agility implementation & monitoring with close product design & supply chain integration (utilising measurements relating to cost, delivery, quality, performance, flexibility, innovation and service)	✓	✓	✓	✓	✓	✓		✓	✓
Framework for Agile Supply Chains (Ismail and Sharifi, 2006) Product design aligned to supply chain design, development & management, aligning supply chain design and design for supply chain		✓			✓			✓	
Strategic Agility Framework (Ismail *et al.,* 2011) Illustrating working stages to achieve agility		✓			✓			✓	
Extended Ansoff Matrix (Sharifi *et al.,* 2006; Sharifi *et al.,* 2013) Consideration of product requirements in line with supply chain	✓	✓	✓	✓	✓		✓	✓	✓

Table 6. 3 – (Continued) Key Areas within the Literature Review and their Coverage/Interactions with the Framework Models Considered in the Theoretical Framework Chapter (Author)

	Management of inventory, information, demand, resources (Lindgreen et al., 2009	Knowledge sharing (Barratt, 2004; Jain et al., 2008)	Close supply chain relationships (Lee, 2004)	Consideration of supply chain as a whole (Balsmeier and Voisin (1996), Bernardes and Hanna (2009), Demmer et al., (2011), Sharifi et al., (2013)	Build agility into supply chains (Christopher and Holweg, 2011; Tang and Musa, 2011)	Operational performance (Ngai *et al.,* 2011; Gligor and Holcomb, 2012)	Financial Operations (Blome et al., 2013; Eckstein et al, 2015)	Align supply and demand to markets (Christopher, 2000; Eckstein et al., 2015)
Agility Road Map (Ismail *et al.,* 2006) Plans & tools for agility implementation & monitoring with close product design & supply chain integration (utilising measurements relating to cost, delivery, quality, performance, flexibility, innovation and service)	✓	✓	✓	✓	✓	✓	✓	✓
Framework for Agile Supply Chains (Ismail and Sharifi, 2006) Product design aligned to supply chain design, development & management, aligning supply chain design and design for supply chain		✓	✓	✓	✓	✓	✓	
Strategic Agility Framework (Ismail *et al.,* 2011) Illustrating working stages to achieve agility		✓	✓	✓	✓	✓	✓	
Extended Ansoff Matrix (Sharifi *et al.,* 2006; Sharifi *et al.,* 2013) Consideration of product requirements in line with supply chain		✓		✓	✓			✓

Table 6. 4 – (Continued) Key Areas within the Literature Review and their Coverage/Interactions with the Framework Models Considered in the Theoretical Framework Chapter (Author)

	Supply chain as a whole benefits (Croom et al., 2000)	Detect change in market environments (Zang and Sharifi, 2000; Li et al., 2008; Li et al., 2009; Whitten et al., 2012; Blome et al., 2013)	Supplier & supply chain new knowledge, skills, products, resources, responsiveness (Christopher, 2000; Narasimhan and Das, 2000; Zhang and Sharifi, 2007; Khan and Pillania, 2008)	Information management and sharing (Sukwadi *et al.*, 2013)	The operating economic and financial situation (Blome *et al.*, 2013; Eckstein *et al.*, 2015)	Attractiveness to supply chain (Mortensen et al., 2008)
Agility Road Map (Ismail *et al.*, 2006) Plans & tools for agility implementation & monitoring with close product design & supply chain integration (utilising measurements relating to cost, delivery, quality, performance, flexibility, innovation and service)	✓	✓		✓	✓	
Framework for Agile Supply Chains (Ismail and Sharifi, 2006) Product design aligned to supply chain design, development & management, aligning supply chain design and design for supply chain	✓			✓		✓
Strategic Agility Framework (Ismail *et al.*, 2011) Illustrating working stages to achieve agility	✓			✓		✓
Extended Ansoff Matrix (Sharifi *et al.*, 2006; Sharifi *et al.*, 2013) Consideration of product requirements in line with supply chain	✓	✓	✓	✓		✓

Table 6. 5 - Key Areas within PFS Model Covering Key Points Relating to Agile Supply Chains Highlighted in Literature Review and Theoretical Framework (Author)

		Key Points Relating to Agile Supply Chains Highlighted within Literature Review and Theoretical Framework										
		Management of international production, increased competition, unstable markets and buyer tastes (Gunasekaran and Ngai, 2005; Cabral *et al.*, 2012)	Obstructions and inefficiencies (Hendricks and Singhal, 2005)	Need to be reactive (Lancioni, 2000)	Levels of flexibility and innovativeness (Prastacos *et al.*, 2002; Bishwas, 2015)	Internal & external supply chain interference (Singh et al., 2011)	Demand unpredictability (Christopher & Holweg, 2011)	Change (Asmussen & Waehrens, 2015)	Supply chains become intertwined information management systems (purchasing, manufacture, warehousing) (Sukwadi et al., 2013)	Balancing risk & suppliers against stakeholders (Borjeson et al., 2015)	Management of inventory, information, demand, resources (Lindgreen et al., 2009)	Knowledge sharing (Barratt, 2004; Jain et al., 2008)
Key Areas Considered within PFS Model	Market	✓	✓	✓			✓	✓				
	Suppliers / Supply Chain	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Relationship with Supplier	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Suppliers and the Future	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Vulnerabilities	✓	✓	✓			✓	✓	✓	✓	✓	
	Environment	✓	✓	✓			✓	✓		✓		
	Product	✓	✓	✓	✓		✓	✓				

Table 6. 6 – (Continued) Key Areas within PFS Model Covering Key Points Relating to Agile Supply Chains Highlighted in Literature Review and Theoretical Framework (Author)

		Key Points Relating to Agile Supply Chains Highlighted within Literature Review and Theoretical Framework											
		Close supply chain relationships (Lee, 2004)	Consideration of supply chain as a whole (Balsmeier and Voisin (1996), Bernardes and Hanna (2009), Demmer et al., (2011), Sharifi et al., (2013)	Build agility into supply chains (Christopher and Holweg, 2011; Tang and Musa, 2011)	Operational performance (Ngai *et al.*, 2011; Gligor and Holcomb, 2012)	Financial Operations (Blome et al., 2013; Eckstein et al, 2015)	Align supply and demand to markets (Christopher, 2000; Eckstein et al., 2015)	Supply chain as a whole benefits (Croom et al., 2000)	Detect change in market environments (Zang and Sharifi, 2000; Li et al., 2008; Li et al., 2009; Whitten et al., 2012; Blome et al., 2013)	Supplier & supply chain new knowledge, skills, products, resources, responsiveness (Christopher, 2000; Narasimhan and Das, 2000; Zhang and Sharifi, 2007; Khan and Pillania, 2008)	Information management and sharing (Sukwadi *et al.*, 2013)	The operating economic and financial situation (Blome *et al.*, 2013; Eckstein *et al.*, 2015)	Attractiveness to supply chain (Mortensen et al., 2008)
Key Areas Considered within PFS Model	Market				✓		✓	✓	✓				✓
	Suppliers / Supply Chain	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
	Relationship with Supplier	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Suppliers and the Future	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
	Vulnerabilities	✓			✓	✓			✓			✓	
	Environment					✓			✓			✓	
	Product				✓				✓	✓	✓	✓	✓

Table 6. 7 – (Continued) Key Areas within PFS Model Covering Key Points Relating to Agile Supply Chains Highlighted in Literature Review and Theoretical Framework (Author)

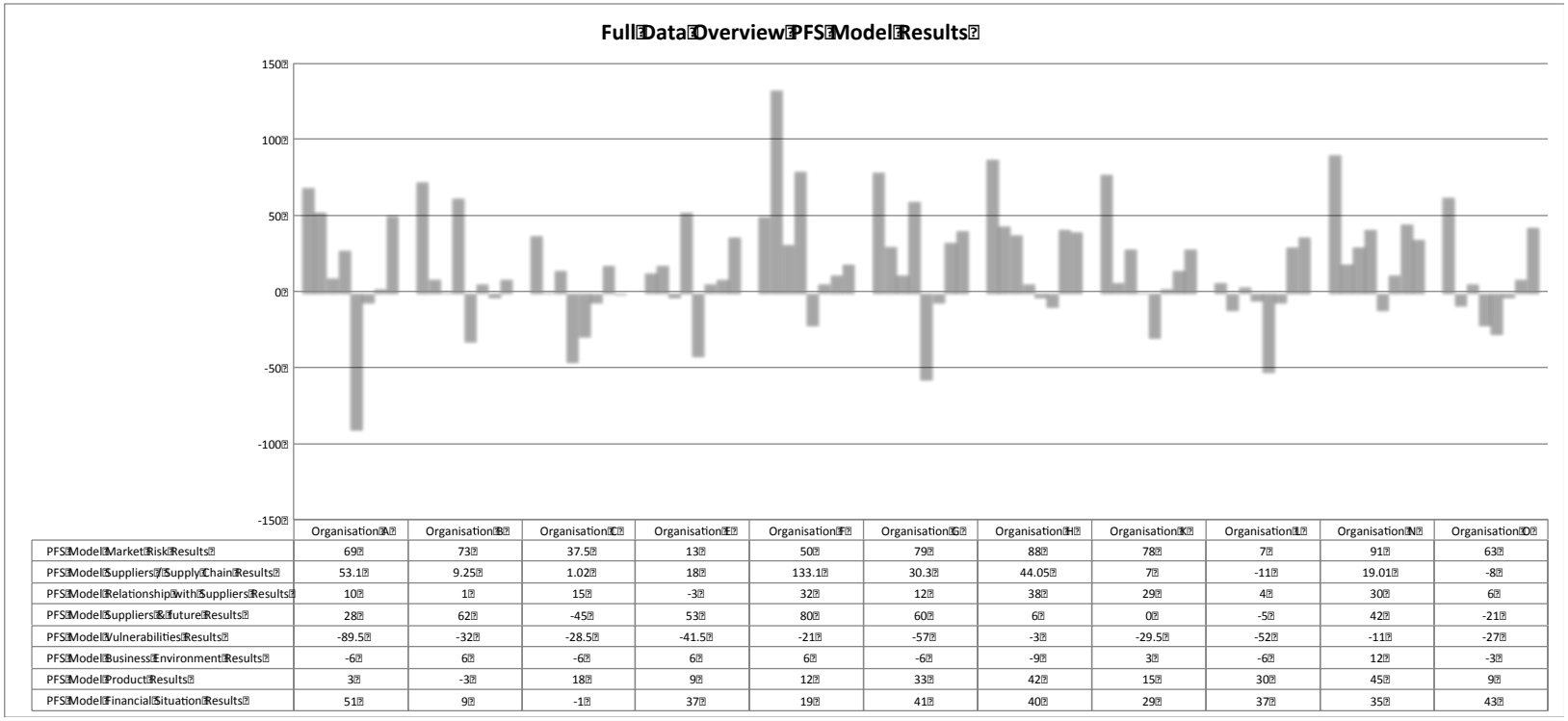
		Key Points Relating to Agile Supply Chains Highlighted within Literature Review and Theoretical Framework				
		Agility Road Map	Framework for Agile Supply Chains	Strategic Agility Framework	Extended Ansoff Matrix	Agile Supply Chain development framework
Key Areas Considered within PFS Model	Market		✓	✓	✓	✓
	Suppliers / Supply Chain	✓	✓	✓		✓
	Relationship with Supplier	✓	✓	✓		✓
	Suppliers and the Future	✓	✓	✓		✓
	Vulnerabilities	✓	✓	✓		✓
	Environment	✓	✓	✓		✓
	Product		✓	✓	✓	✓

The framework models cover a broad area of the agility-related points highlighted in the Literature Review. Having acknowledged the breadth and practical applicability of the new model relative to the strategic frameworks upon which it has been built, consideration can be turned to the outputs from its use. Following feedback from the SME organisations involved and identified in the previous chapter, the PFS Model data outputs were deemed to provide accurate overviews of the present functioning states for each organisation.

Whilst all organisations accepted the accuracy of the outcomes, only Organisation G has purposefully utilised them to change elements of their operation (providing evidence to support Sharifi *et al.,* (2009). Organisation A acknowledges the outcome but is reticent to consider any further use of them. Given the means and approach the company has towards their processes this not unexpected. Organisations B, E, F and H found the outcomes accurate and of interest but at the present time due to the size of their businesses have not made any immediate changes. Out of these companies, Organisation B showed the most interest in its results and a number of discussions evolved, examining their meaning and how they might affect the company's future. They were particularly interested in improving quality issues and integrating them within the supply chain. Organisations C, K, L, and N believe they will utilise elements of their results in the near future. Organisation O believes its results to be accurate but due to the nature of its business does not believe it will make alterations to how it operates in the near future as at present the owner states 'we just do what we do – it's cold.'

The fact that the model has not been operationally adopted at this stage does not impact this research. What is important is that the organisations believe the PFS Model to be presenting a true picture of their present operating states with a good degree of accuracy – a solid foundation from which to acknowledge its benefits and use. Possibly the most promising aspect of the feedback received comes from the owner of Organisation G who implemented its PFS Model results (as well as those from the Conjoint and Repertory Grid Analyses), commenting about it accurately illustrating its present state of operations with the statement "Absolutely… it's accurate to the nature of the business."

Due to the PFS Model being a diagnostic rather than a benchmarking tool, as anticipated there are no direct data output correlations between organisations, as evidenced in Figure 6. 2. Whilst there are clearly organisations that illustrate similar output trends, there appears to be no clear indication of this happening in the majority of instances, substantiating the fact that the PFS Model cannot be utilised as a means of comparison between one organisation and another.



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Market Risk Results	69	73	37.5	13	50	79	88	78	7	91	63
PFS Model Suppliers / Supply Chain Results	53.1	9.25	1.02	18	133.1	30.3	44.05	7	-11	19.01	-8
PFS Model Relationship with Suppliers Results	10	1	15	-3	32	12	38	29	4	30	6
PFS Model Suppliers & Future Results	28	62	-45	53	80	60	6	0	-5	42	-21
PFS Model Vulnerabilities Results	-89.5	-32	-28.5	-41.5	-21	-57	-3	-29.5	-52	-11	-27
PFS Model Business Environment Results	-6	6	-6	6	6	-6	-9	3	-6	12	-3
PFS Model Product Results	3	-3	18	9	12	33	42	15	30	45	9
PFS Model Financial Situation Results	51	9	-1	37	19	41	40	29	37	35	43

Figure 6. 2 – PFS Model Overview of All Results for each Section/Question Area (Author)

Whilst accepting the validity of the results, it is relevant to consider the point made by Herbane (2010) with respect to the lack of research and its inappropriateness when considering the challenges SMEs face. It can be argued that developing the PFS Model has provided appropriate research relating to the challenges SMEs face. At the same time, the model has gone beyond the initial goal of identifying the present operating state of an SME's supply chain. Whilst accepting there are no clear correlations between each element of the aggregated PFS Model results, what is apparent is that on the whole, the smaller organisations present more negative results than their larger counterparts.

The PFS Model has thereby identified key areas of challenges and provides the means from which SMEs can identify their standing within these areas. The model provides the measures to overcome the point made by Pollard and Hotho (2006) who suggested many SMEs exist in a state of denial with regards uncertainties, citing a lack of resources or the likelihood of impact as reasons for not acting. Given the workability of the PFS Model, the resources are hereby available to potentially all SMEs to identify their standing and help progress their agility.

As identified in the Literature Review chapter, Lee (2004) argued the need for supply chains to identify trends so as to adapt to markets. Whilst trends per se cannot be identified within the PFS Model data, the data sample enables a ranked set of amalgamated results to be created based upon the PFS Model sectional areas. This ranking of amalgamated results for all partaking organisations signifies the most positive through to the most challenging areas for SMEs highlighted by the PFS Model (illustrated in Table 6. 8).

Table 6. 8 – Ranked Order of Amalgamated Results from PFS Model Areas for all Participating SMEs (Author)

Ranked Order of Amalgamated Results	PFS Model Area
1	PFS Model Market Risk Results
2	PFS Model Suppliers / Supply Chain Results
3	PFS Model Financial Situation Results
4	PFS Model Relationship with Suppliers Results
5	PFS Model Suppliers and the Future Results
6	PFS Model Product Results
7	PFS Model Business Environment Results
8	PFS Model Vulnerabilities Results

The ranking was achieved through the following process:

a) Within each PFS Model area, the questionnaire-interviews allow for a minimum and maximum range of scores – this is the spread.
b) As the spreads are unequal, a calculation is performed to identify each PFS Model area score as a proportion of the spread.
c) The scores for all organisations are totalled from each PFS Model area.
d) The resultant totals are ranked, relative to the proportional value of the PFS Model area spread.

From the perspective of an individual organisation utilising the PFS Model, this ranking is of little interest. For the purpose of this study the ranking identifies a more globalised and generalised approach that might be taken should such categorisation be required. These results draw together issues highlighted by Ismail and Sharifi (2006) in the *framework for agile supply chains* and Ismail and Sharifi (2006) and the concepts of *supply chain design* and *design for supply chain* in terms of the close results relating to *products*, the *environment* and *vulnerabilities*. They also highlight the close proximity between the *market* and *suppliers* (Ismail and Sharifi, 2006).

In ranking and associating these factors and acknowledging the point made by Christopher (2000) that supply chains have become misaligned, these PFS Model results are in fact drawing the supply chain (and product) factors together as a whole – effectively creating alignment - to meet market demands (and therein supporting the point made by Sharifi *et al.,* 2013). The PFS Model supports the argument explored by Fawcett and Waller (2014) indicating that internal-external supply chain divides are only conceptual – the supply chain must operate as an entity to be fully efficient. These results indicate the key areas and align both the internal and external factors therein.

Having identified a ranking, the results of each PFS Model can now be considered in turn.

- **PFS Model Market Risk Results**

The market risk results are illustrated in Figure 6. 3.

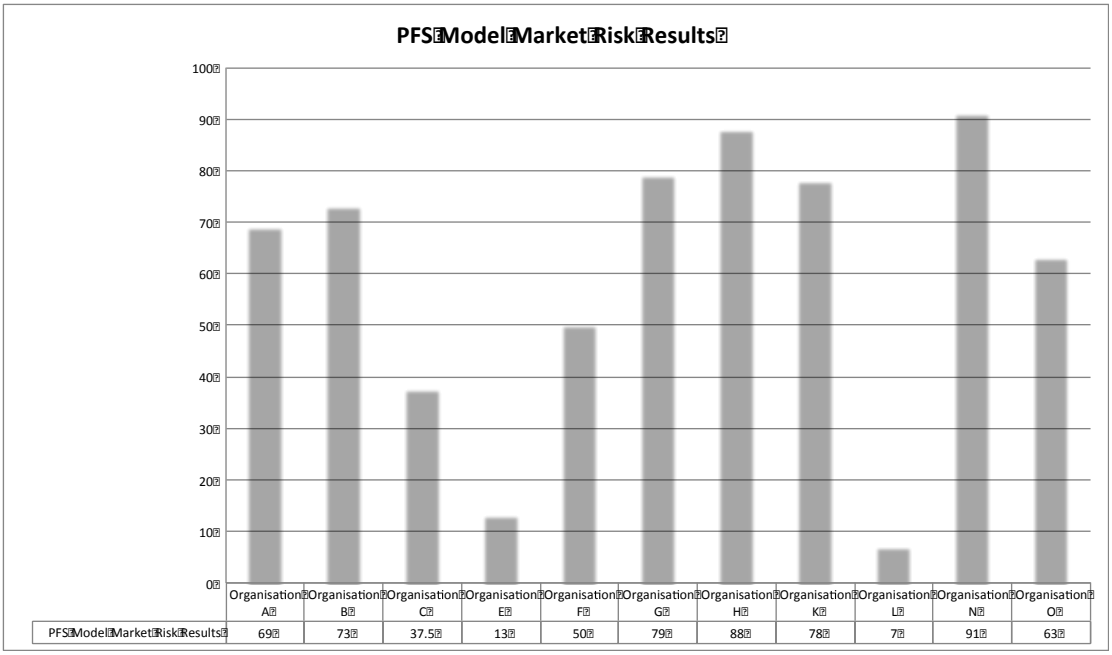


Figure 6. 3 – PFS Model Market Risk Results (Author)

From the amalgamated data set, the highest-ranking results are based upon the reasonably straightforward issue of understanding technical aspects of the market in which the organisations sit. The lowest results come from *Organisations L* and *E*. In the case of *Organisation L,* the market was clearly acknowledged as a risk (due to the nature of local and national competition). *Organisation E* faces similar international risks yet both companies believe they will expand in the future.

The remaining organisations have (on the whole) utilised various aspects of the adaptation models highlighted in the Literature Review (economies of scale (Peaucelle, 2000), quality (Crosby, 1979; Deming, 1986; Juran, 1988), overseas outsourcing (Platts and Song, 2010) and lean production philosophies (Lucio, 2013). However, whilst these models bring advantages to those SMEs adopting them, the lack of stable demand and continuous production (in line with Naim *et al.,* 1999) has resulted in inconsistent results. *Organisation A* for example adopted overseas outsourcing, quality and lean production philosophies yet at times has to work counter to these values to meet customer requirements. *Organisation L* has also adopted these working methods yet still faces market risks due to its size and the control held by suppliers within the market.

- **PFS Model Suppliers and Supply Chain Results**

The results for the PFS Model Suppliers and the Supply Chain results are illustrated in Figure 6. 4.

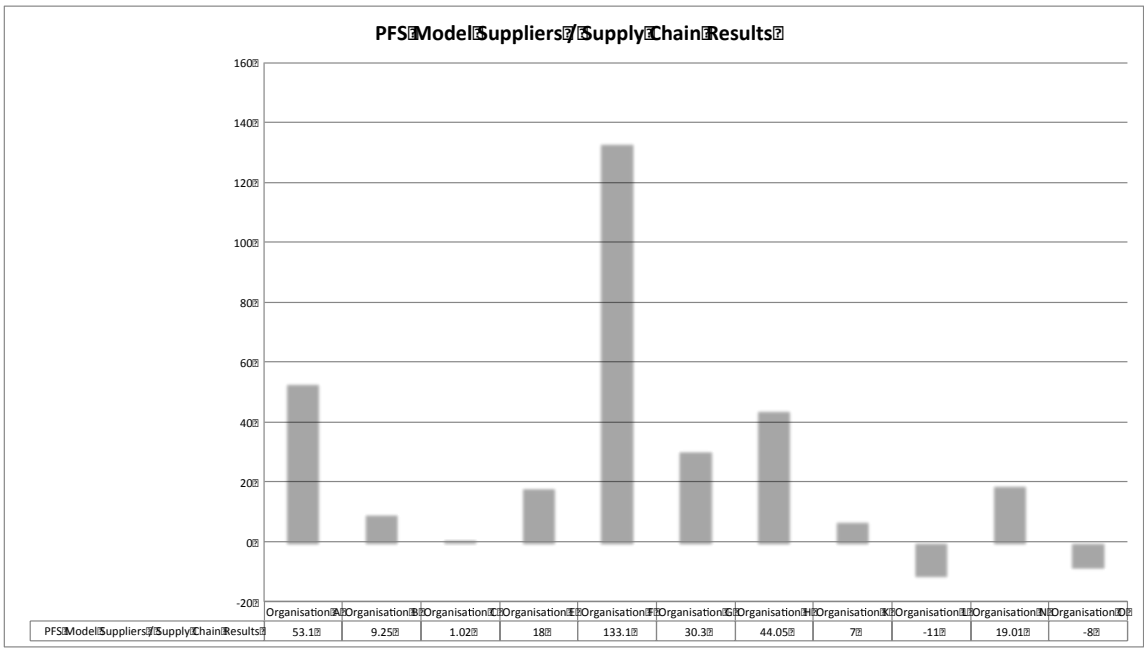
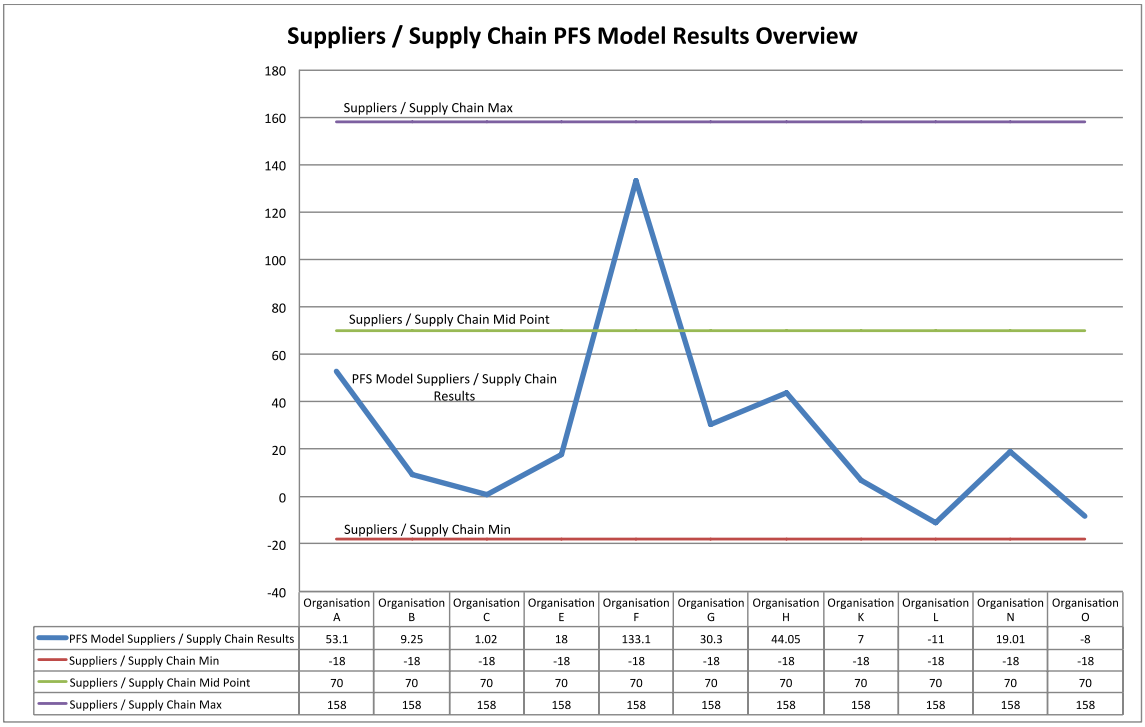


Figure 6. 4 - PFS Model Suppliers and Supply Chain Results (Author)

As might be anticipated following the interviews conducted in the data gathering process (illustrated in the Findings chapter, page 121), *Organisation F* has the strongest result relating to its suppliers and supply chains, and it can be argued that this strong outcome is skewing the results for the dataset as a whole. Given that *Organisation F* has by far the largest turnover in the study, it would be logical to assume it has correspondingly strong supply chain links (as suppliers are keen to work with the company).

Of equal significance here are the outcomes from the other organisations. With the exception of *Organisation F*, each organisation's data outputs were below the *mid-point* of potential outcomes (illustrated in Figure 6. 5).



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Suppliers / Supply Chain Results	53.1	9.25	1.02	18	133.1	30.3	44.05	7	-11	19.01	-8
Suppliers / Supply Chain Min	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18
Suppliers / Supply Chain Mid Point	70	70	70	70	70	70	70	70	70	70	70
Suppliers / Supply Chain Max	158	158	158	158	158	158	158	158	158	158	158

Figure 6. 5 - PFS Model Suppliers and Supply Chain Results Showing Minimum and Maximum Possible Data Outcomes (Author)

Organisation B (with another correspondingly high turnover) has a low outcome relative to other respondents, yet this is unsurprising due to the comments made and the acknowledgement of its poor supply chain relationships (*Attitude to Suppliers* section, page 219). These as well as the other results fall in line with expectations following the interviews, thus illustrating that the PFS Model is accurately identifying the present operating situation for these companies.

Whilst acknowledging these results, it is important to consider points made in the Literature Review by Kumar and Sosnoski (2011) who suggest that many organisations do not believe supply chain resilience to be an integral element of their risk strategy, subsequently overlooking it. This may well be the case in these situations and it is arguably relevant to consider Gunasekaran *et al.,* (2011) who contended the need for SMEs to consider their strategies and operating practices in such situations – even when simplistic management practices are operating (Parnell *et al.,* 2015).

- **PFS Model Financial Situation Results**

The results for the PFS Model Financial Situation results are illustrated in Figure 6. 6.

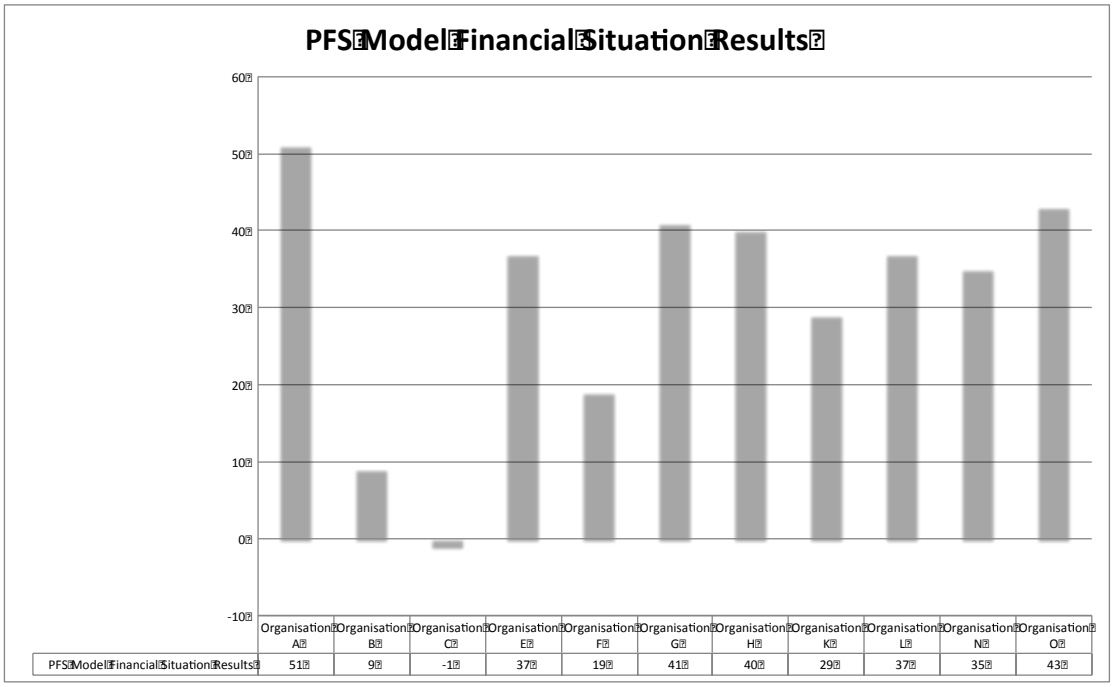


Figure 6. 6 - PFS Model Financial Situation Results (Author)

With reference to the Literature Review chapter, Gunasekaran and Ngai (2005) believed factors of economics to have been given less than anticipated significance in the strategic design of supply chains, a point supported by Luo and Zhao (2013) who argued that economic strategies play a significant role in organisational performance relative to operating conditions. Whilst SMEs are more likely to feel the impact of economic issues than their larger counterparts (Ahmad *et al.,* 2012), the vast majority of participating organisations are aware of financial and economic issues and invest time into monitoring them. With these points in mind it is important to consider the PFS Model *Financial Situation* results that indicate broad swings in the levels of economic interaction between participating SMEs.

Notably, the SMEs with the smallest turnovers indicate similar results for financial interest and management. A surprising result comes from the fact that *Organisation B* (with a turnover of £13 million) and *Organisation F* (with a turnover of £45 million) have two of the lowest scores for such management issues (only *Organisation C* has a lower score which is understandable due to the lack of debt within the company and the way it operates). A postulation here may be that due to their size, these companies are less concerned with financial and economic factors. Due to both SMEs being cash

rich and debt free privately owned entities, this may explain the outcome, but it raises other questions for these companies in as much as whilst general financial and economic issues may be considered from an internal perspective, evidence suggests there is little consideration of how such issues affect customers or others in the supply chain – factors that could impact their operations significantly. Accordingly, supply chain agility may require further consideration relative to Gunasekaran and Ngai (2005), Luo and Zhao (2013) for these organisations.

- **PFS Model Relationship with Suppliers Results**

The results for the PFS Model Relationship with Suppliers results are illustrated in Figure 6. 7.

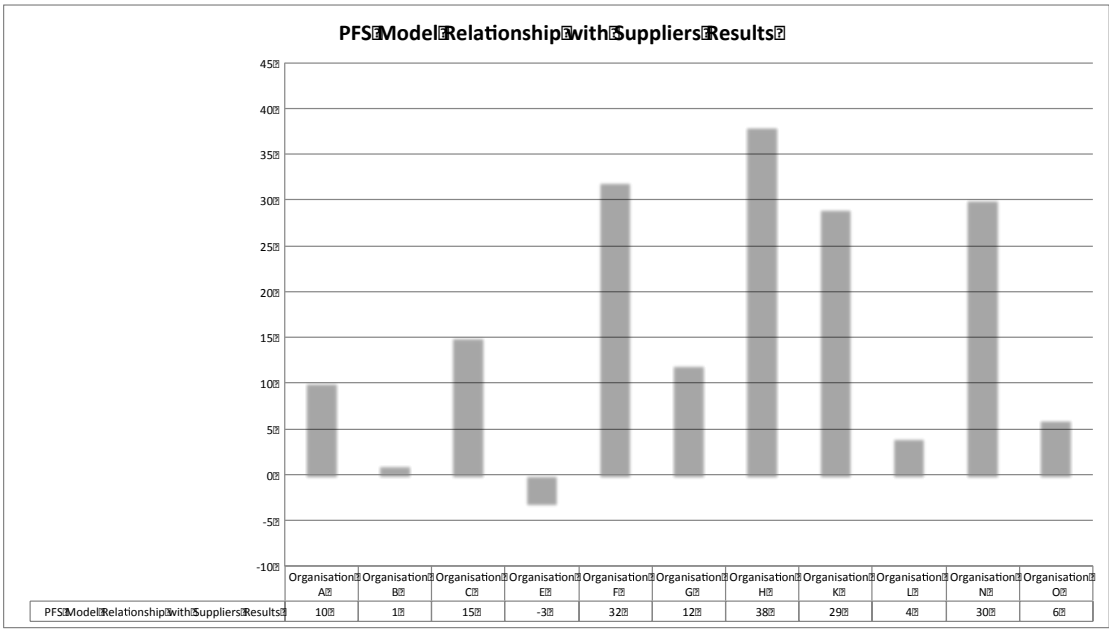
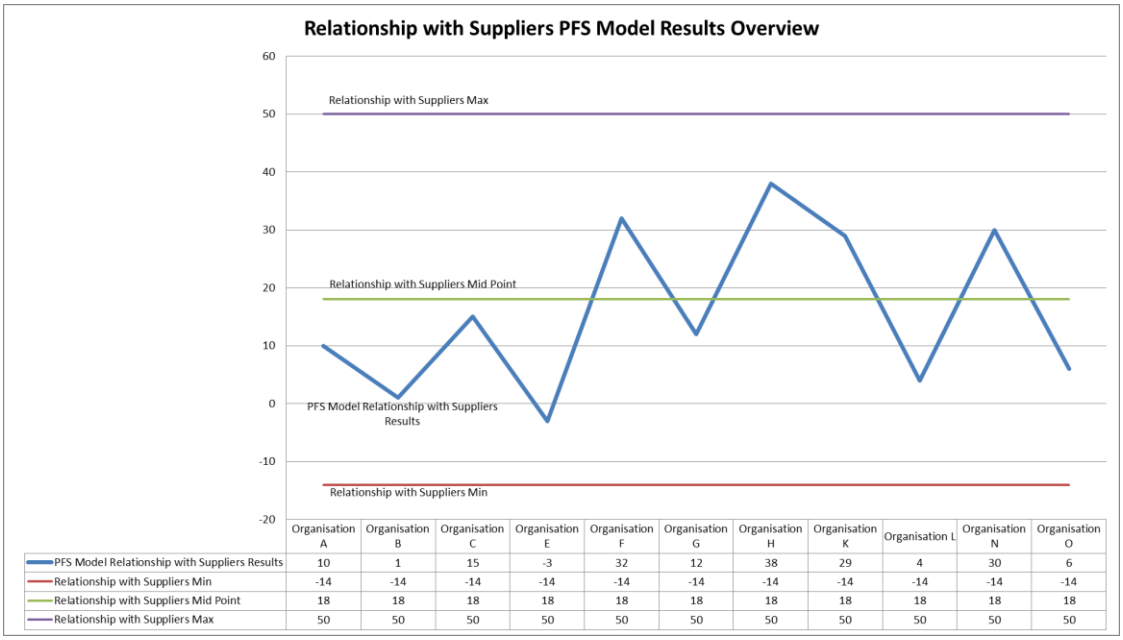


Figure 6. 7 - PFS Model Relationship with Suppliers Results (Author)

Whilst there are clear variations in the results regarding supplier relationships, these outcomes show a significant improvement on the *Suppliers and Supply Chain* data, illustrating that supply chain communications and relationships do exist for a number of these organisations. The results are also not extreme relative to the potential PFS Model minimum and maximum outcomes (illustrated in Figure 6. 8).



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Relationship with Suppliers Results	10	1	15	-3	32	12	38	29	4	30	6
Relationship with Suppliers Min	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14
Relationship with Suppliers Mid Point	18	18	18	18	18	18	18	18	18	18	18
Relationship with Suppliers Max	50	50	50	50	50	50	50	50	50	50	50

Figure 6. 8 - Relationship with Suppliers PFS Model Results Overview (Author)

Whilst each outcome aligns with expectations and has been confirmed for its relevance by the organisations concerned, it is clear that the larger organisations *F* and *H* have the highest scores in this area of the PFS Model. It is also significant to note that the smaller organisations *K* and *N* who seemingly have relatively few suppliers to purchase from (and from whom purchase prices are effectively *set*, in line with Cox, (1999)) have reasonably high responses whereas organisations *L* and *O* have relatively low responses (in areas where supplier choice might appear to be greater). One explanation for this comes from the fact that *Organisation N* will negotiate with suppliers, and *Organisation K* contacts multiple suppliers for the best prices prior to placing an order. Whilst *Organisation G* has a relatively low score, the company is notably proactive in developing its agility, and provided evidence to illustrate the developing nature of its supplier relationships. Such proactivity could be beneficial to suppliers and could ultimately save money (in line with Cordon and Vollmann, 2002; Christiansen and Maltz, 2002; Ellegaard and Ritter, 2006).

It is significant to note that Organisations *B* and *E* with relatively high turnovers have the lowest response rates in this section. In both instances the companies were less interested than might have been expected in their supplier relationships (such actions being misaligned to Caloffi *et al.,* (2015) who suggested relationships to be important elements of partnerships). This is surprising and with reference to Bhamra and Dani (2011) from the Literature Review is something that should be considered carefully as poor supplier relationships can lead to business failures. Should these companies wish to have their

needs met as purchasers (in line with Handfield *et al*., 2000), buyer-seller relationships should be deliberately developed with all parties involved in the process to bring about the required outcomes (Mortensen *et al.,* 2008). One way to improve such relationships is through information sharing (in line with Childerhouse and Towill, 2003) to ensure relationship stability (in line with Li *et al.,* 2006).

- **PFS Model Suppliers and the Future Results**

The Suppliers and the Future PFS Model results are illustrated in Figure 6. 9.

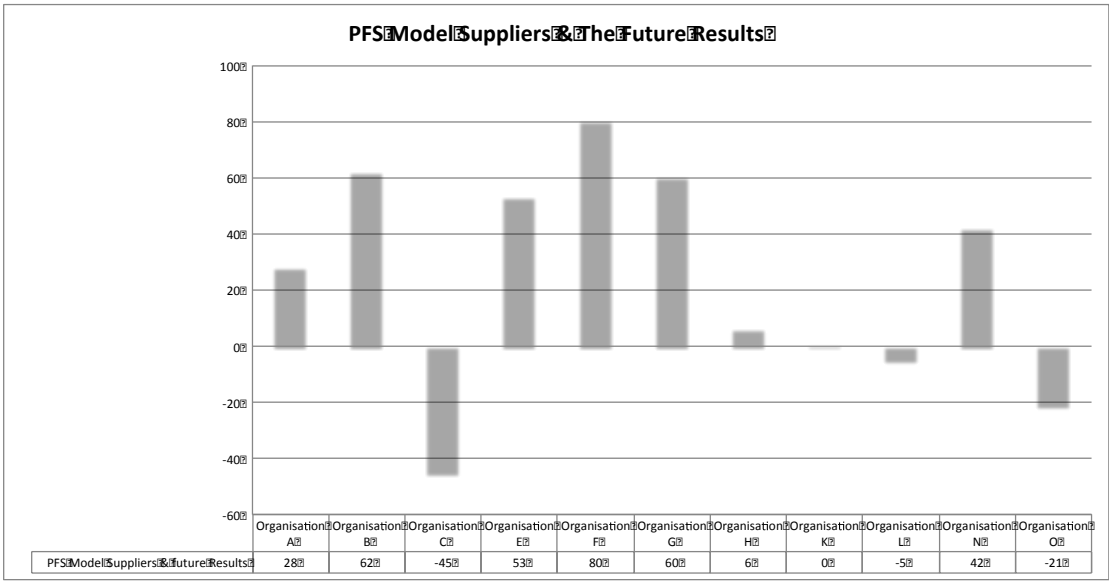
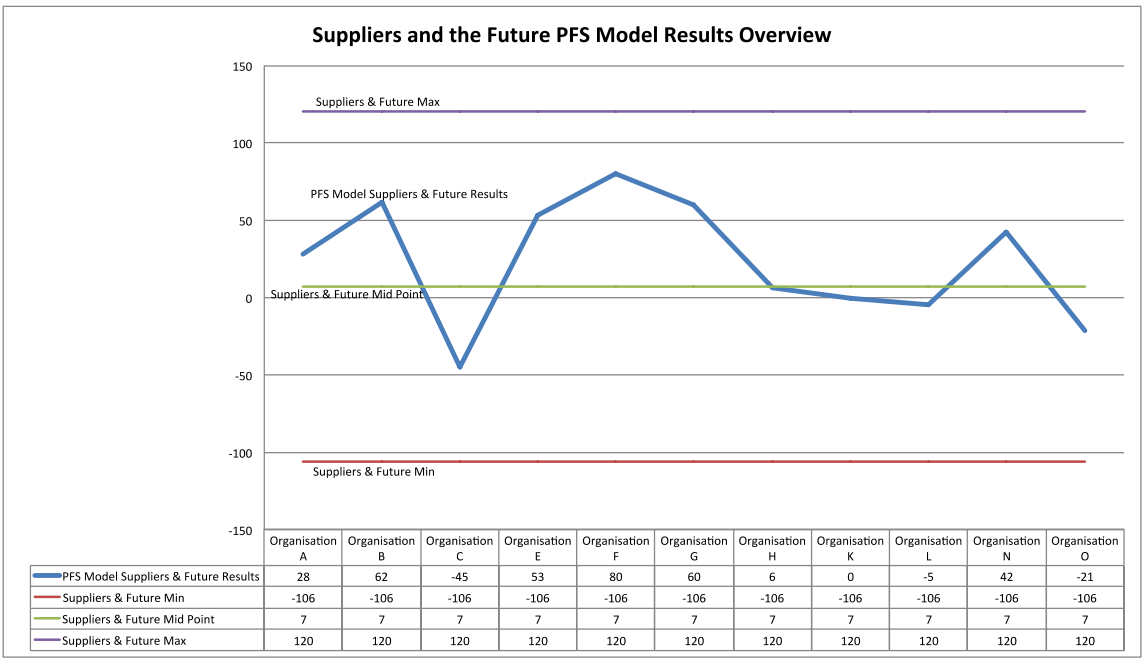


Figure 6. 9 - PFS Model Suppliers and the Future Results (Author)

Whilst there are again clear differences in the responses for this element of the data, with the exception of *Organisation H* it is very clearly the smaller SMEs that are facing a less optimistic future regarding suppliers. It should be pointed out that *Organisation O* acknowledged little interest in suppliers and the future, but this is unusual and contradicts Caloffi *et al.,* (2015), Bhamra and Dani (2011) and Mortensen *et al.,* (2008). Organisations *B* and *E* believe they have relatively poor supplier relationships at present but foresee improvements.

Further to these points it is important to note the minimum and maximum response data limits for *Suppliers and the Future* (Figure 6. 10).



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Suppliers & Future Results	28	62	-45	53	80	60	6	0	-5	42	-21
Suppliers & Future Min	-106	-106	-106	-106	-106	-106	-106	-106	-106	-106	-106
Suppliers & Future Mid Point	7	7	7	7	7	7	7	7	7	7	7
Suppliers & Future Max	120	120	120	120	120	120	120	120	120	120	120

Figure 6. 10 – Suppliers and the Future PFS Model Results Overview (Author)

The point of note here is that whilst the present supply chain situation is (on the whole) less than positive, these organisations have lines of communication with suppliers illustrating interactions between the said parties exist. They furthermore perceive these relationships will improve in the future. From the standpoint of developing agile supply chains this is a positive position to hold – whilst acknowledging the challenges of the present situation, there is belief they will be overcome in the future – they do not see a 'them and us' scenario continuing. Having identified this via the PFS Model, the organisations are in a position to utilise tools such as the *roadmaps* considered in the following chapter to bring about their agile supply chains. However – to do this the organisations in question must be willing to change and develop. A company unwilling to challenge the supply chain status quo such as *Organisation A* will simply remain in their present position.

- **PFS Model Product Results**

The Product PFS Model results are illustrated in Figure 6. 11.

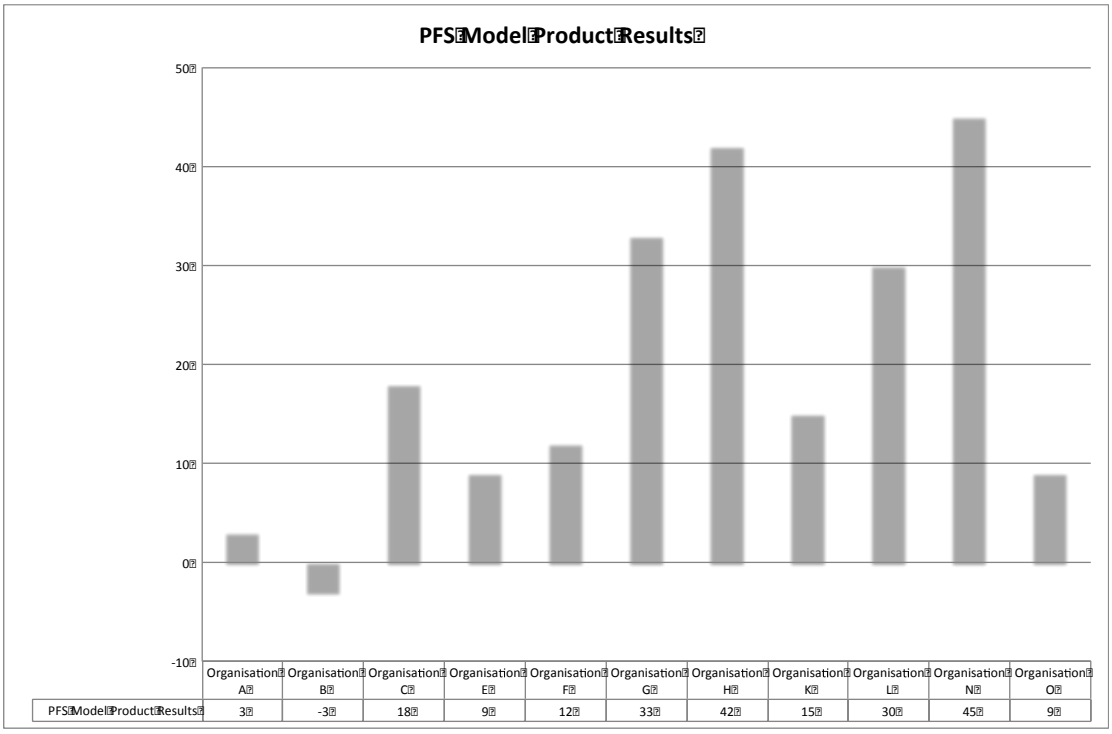


Figure 6. 11 – PFS Model Product Results (Author)

With the exception of *Organisation B*, all organisations present positive responses regarding their merchandise which supports the need for high quality products as argued by Fliedner and Vokurka (1997), Gunasekaran (1999), Yusuf *et al.,* (1999), Menor *et al.,* (2001), and Abbasi *et al.,* (2014). The reasoning for *Organisation B* having a low response is due to its general perception of the quality of the products it sells (whilst at the same time acknowledging the very high quality of the few products it manufactures itself). It is believed *Organisation A's* relatively low score can be aligned to both its poor stock control system (aligned to its supply chain), its subsequent production processes and its wish to see products as entities without the identification of individual product features.

It is interesting to consider the correlations between the relationships with suppliers and products between participating SMEs (illustrated in Figure 6. 12).

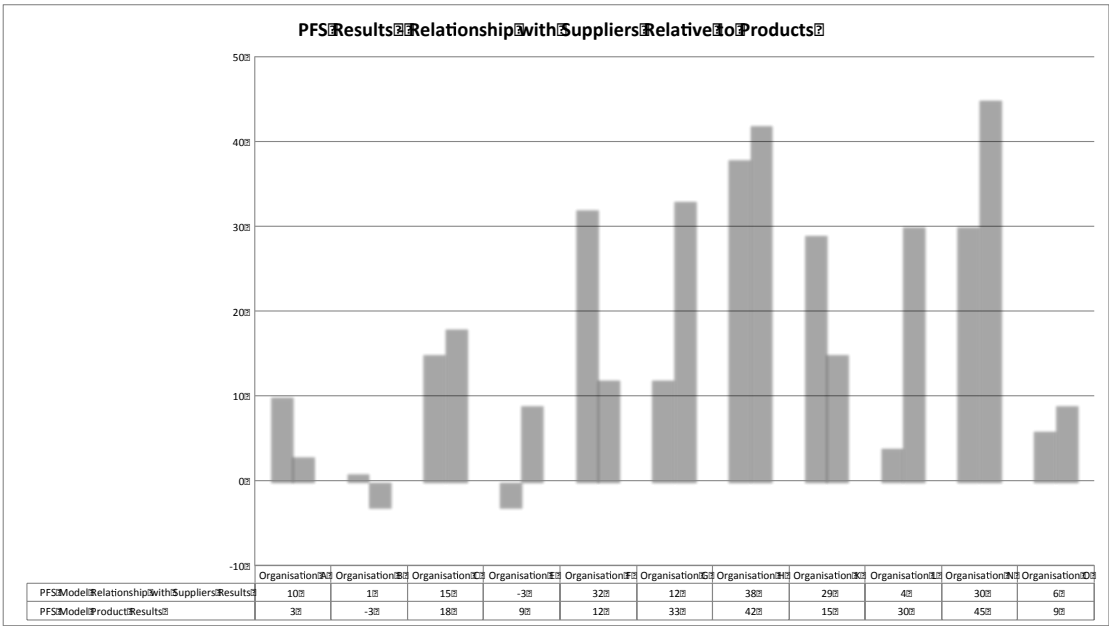


Figure 6. 12 – PFS Model Results – Relationship with Suppliers Relative to Products (Author)

Whilst it is possible to align these two dataset outputs in some instances (Organisations *C, H, N* and *O*), the other organisations hold no such clear correlations. In the case of *Organisations B*, *L* and *G*, their reliance on geographically dispersed suppliers may be affecting this output (in line with Zhang and Gregory, 2011), yet to maintain competitive advantage they need to consider supply chain relationships in line with products (Chandra and Grabis, 2007).

- **PFS Model Business Environment Results**

The PFS Model Environment results are illustrated in Figure 6. 13.

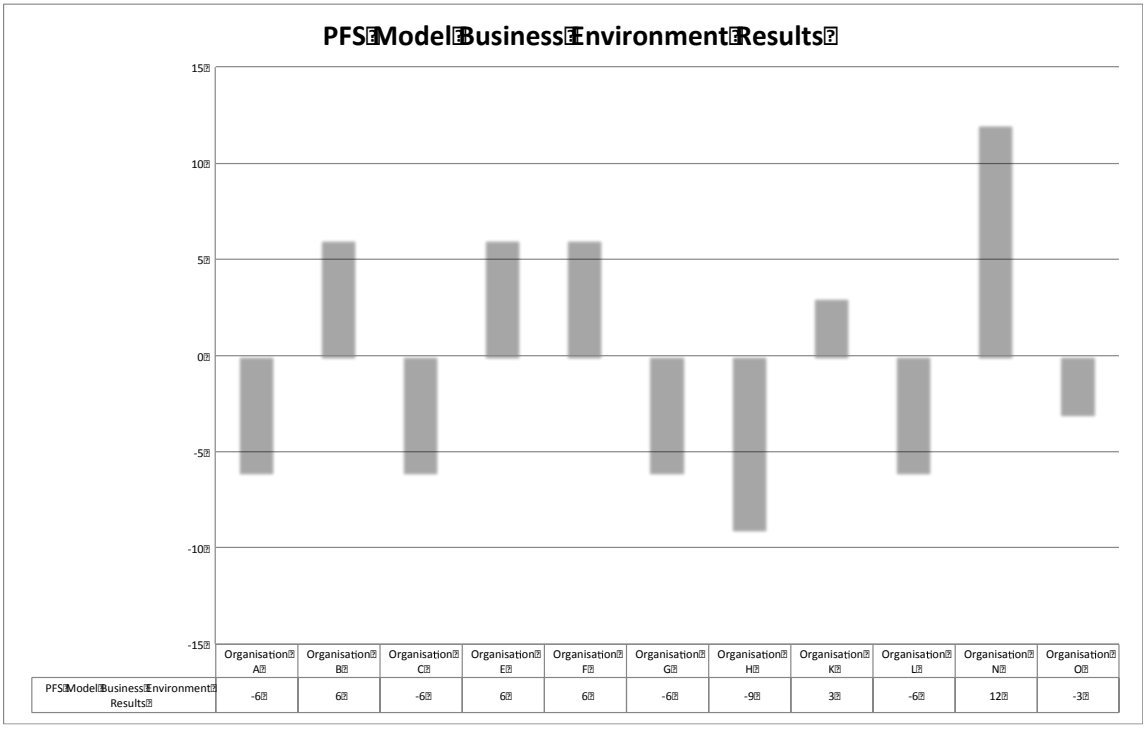


Figure 6. 13 – PFS Model Business Environment Results (Author)

The results herein are of particular interest as they are less positive than might be anticipated. Three of the largest organisations provide positive outcomes while the majority of the smaller companies indicate negative results here. The point of note comes from the fact that the business environment results ought to be closely aligned to the financial situation results in line with Venkatraman and Prescott (1990) and Hallavo (2015) yet there appears to be little correlation (illustrated in Figure 6. 14). This would suggest that these SMEs should be considering aligning their strategic outlook to the external environment to improve their performance, in line with Luo and Zhao (2013).

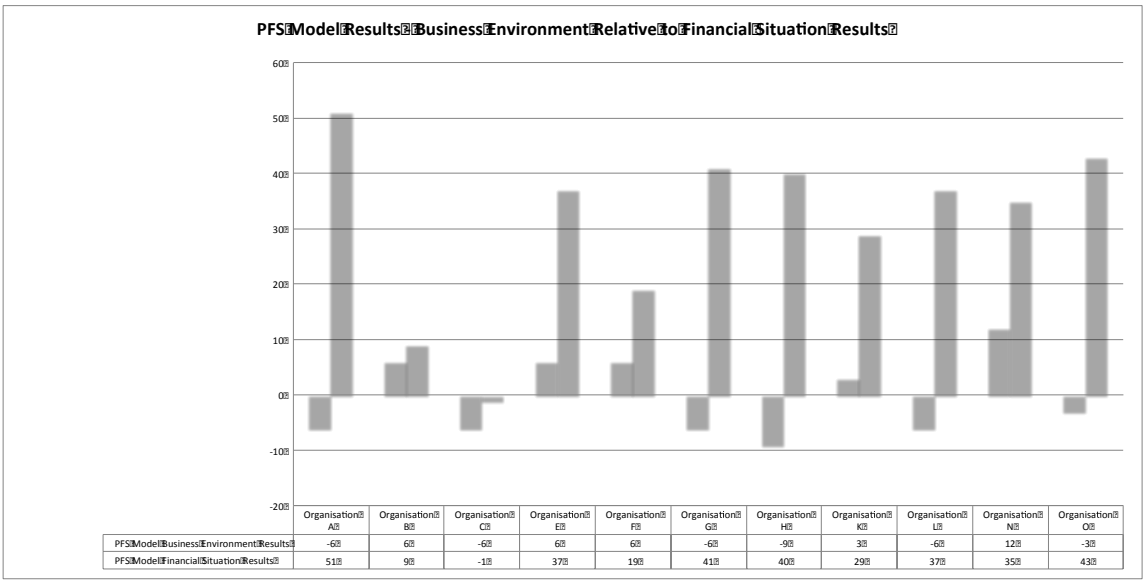
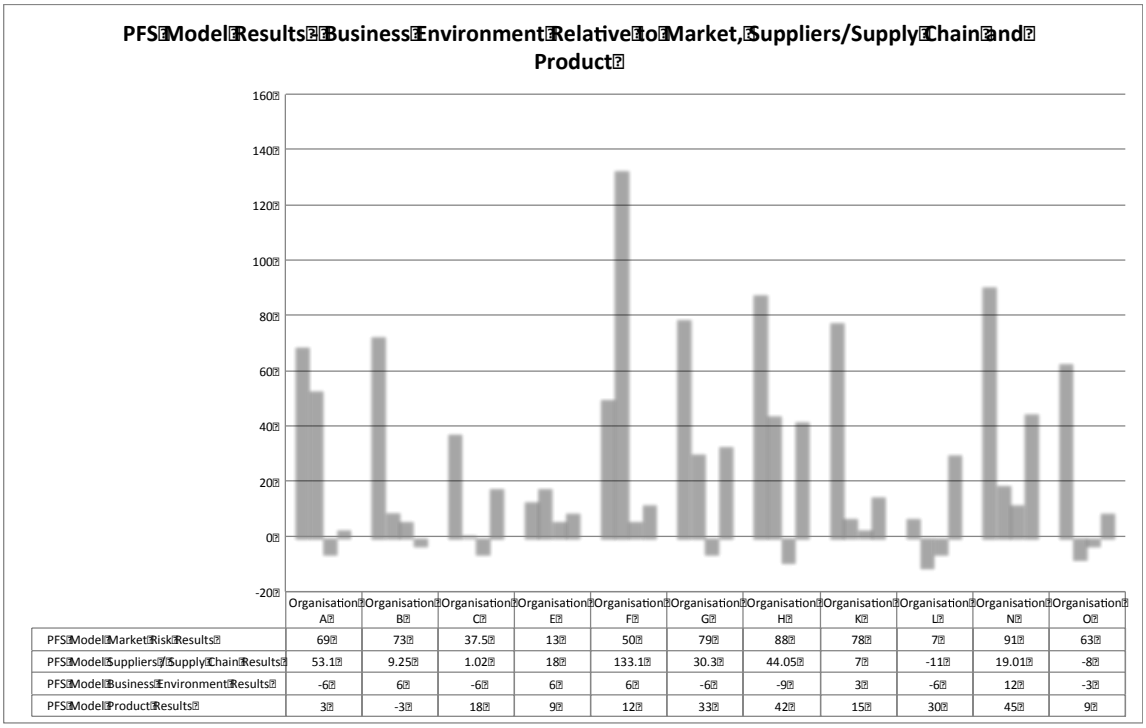


Figure 6. 14 – PFS Model Results Comparing the Business Environment to the Financial Situation Outputs (Author)

Having highlighted this, it is important to consider Ismail and Sharifi (2006) and how products should be designed in line with the market, business environment and the supply chain (the data alignment of which is illustrated in Figure 6. 15).



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Market Risk Results	69	73	37.5	13	50	79	88	78	7	91	63
PFS Model Suppliers/Supply Chain Results	53.1	9.25	1.02	18	133.1	30.3	44.05	7	-11	19.01	-8
PFS Model Business Environment Results	-6	6	-6	6	6	-6	-9	3	-6	12	-3
PFS Model Product Results	3	-3	18	9	12	33	42	15	30	45	9

Figure 6. 15 – PFS Model Results Comparing Environment to Market, Suppliers and the Supply Chain and Product (Author)

There is clearly little or no correlation between the said factors, raising a further issue in line with Koza and Lewin (2000) who suggested the key rationale for entering a partnership is to add to and support the strategies of the chain's parent organisation. Given that these organisations are members of supply chains, and when considering Ismail and Sharifi (2006) and the concepts of *supply chain design* and *design for supply chain*, it becomes clear that for these organisations to develop agile supply chains and bring the *framework for agile supply chains* (Ismail and Sharifi, 2006) into effect with this sample group, each of the factors illustrated in Figure 6. 15 need to be aligned.

In highlighting this, the PFS Model has clearly illustrated the misaligned areas within the sample SMEs. It is showing that whilst fully operational and functioning, these companies have some way to go prior to developing agile supply chains. The PFS Model is therefore proven to be effective in aligning the strategic framework example with the operations of the sample companies.

- **PFS Model Vulnerabilities Results**

The PFS Model Vulnerabilities results are illustrated in Figure 6. 16 and are the lowest ranking results emanating from the model.

It is interesting to note that each participating organisation acknowledged their vulnerability. Whilst some of this can be assigned to market and economic factors, a key element of these scores is due to *supply chain vulnerability* – the dominance of suppliers serving these SMEs. This again supports the supply chain misalignment argument by Christopher (2000) and Bhamra and Dani (2011).

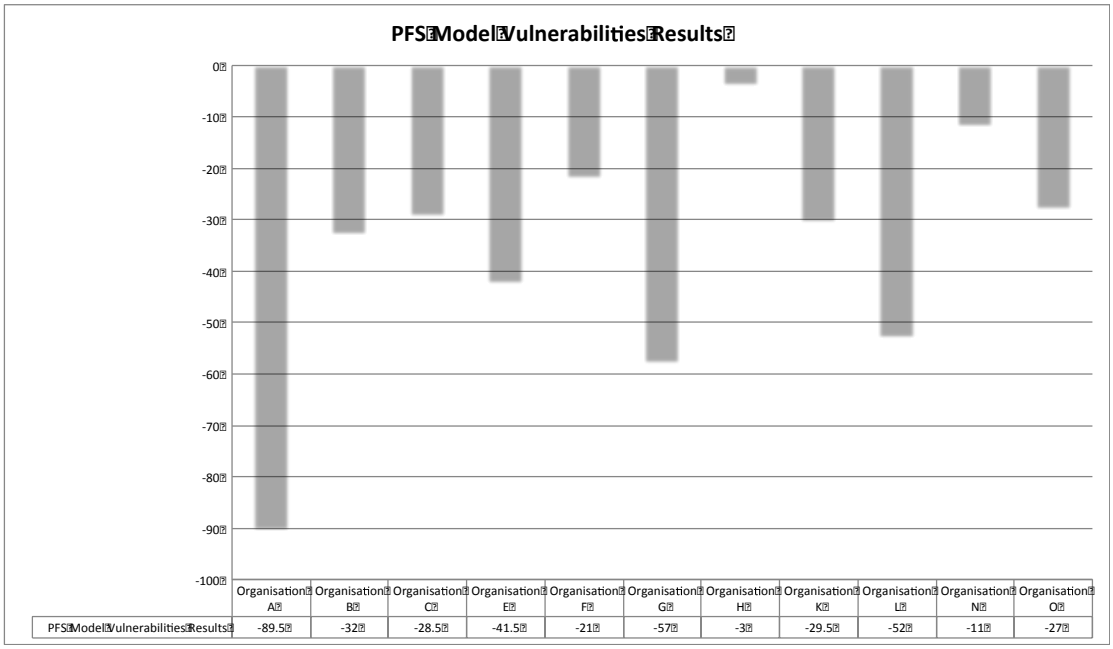


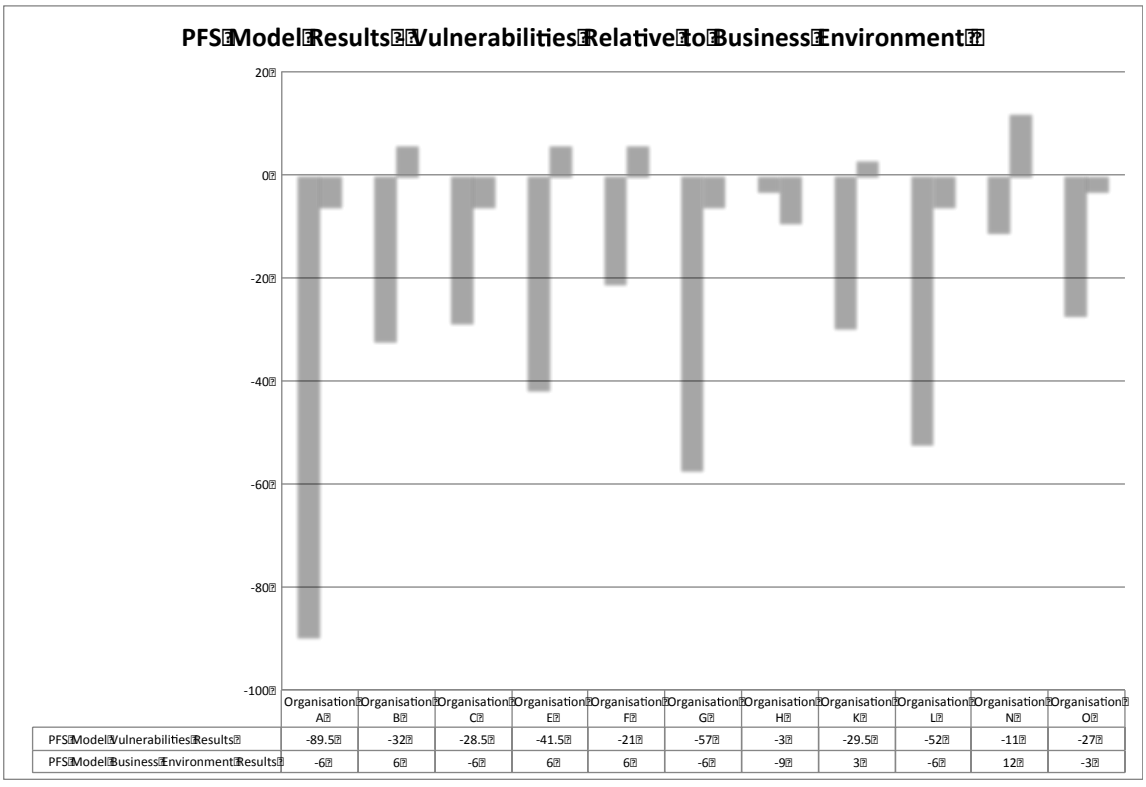
Figure 6. 16 – PFS Model Vulnerability Results (Author)

The Literature Review highlighted Vargo and Seville's (2011) argument that suggested SMEs are more vulnerable than their larger counterparts (a point supported by Wagner and Neshat, 2010; Thun *et al.,* 2011). This is of interest as two of the best results here come from Organisations *F* and *H* – companies with two of the highest turnovers in the sample. The other, smaller organisations face more substantial levels of vulnerability.

A potentially unusual outcome herein is that of *Organisation B* (with a high turnover) that considers itself to be vulnerable relative to other results. This can be accounted for with the state of the market the

company operates in and its unpredictability. Its supply chain interactions also play a part in this result too.

The results herein become more interesting when compared to results relating to the *Business Environment* (Figure 6. 17 – significantly highlighted by authors such as Pan and Nagi (2013) through their argument for the need for organisations to work in competitive, changing and uncertain market environments.



	Organisation A	Organisation B	Organisation C	Organisation E	Organisation F	Organisation G	Organisation H	Organisation K	Organisation L	Organisation N	Organisation O
PFS Model Vulnerabilities Results	-89.5	-32	-28.5	-41.5	-21	-57	-3	-29.5	-52	-11	-27
PFS Model Business Environment Results	-6	6	-6	6	6	-6	-9	3	-6	12	-3

Figure 6. 17 – PFS Model Vulnerabilities Relative to the Business Environment Results(Author)

Over half the *Business Environment* results are negative, and those that attain positive status provide low scoring outcomes. In identifying these points, and in line with the Agility Road Map (Ismail *et al.,* 2006), the model identifies the turbulence faced by these SMEs.

6.3 Product Features

While the PFS Model identifies the current operating position an SME finds itself in, to progress and develop agile supply chains, companies need to align this position with product features and their subsequent future business operations and supply chain. The importance of product features was considered and discussed in the literature review and theoretical framework chapters. Practically, product features are being considered in this research through the use of Conjoint Analysis (in line with Sarlin *et al.,* 2015) due to its long-term use in marketing (Caldwell, 2015).

- **Conjoint Analysis Output Results**

Whilst each participating SME considers their product features to be important to their future, it was surprising that 36% of them were not able to provide product feature data for use in a Conjoint Analysis. When prompted, these organisations acknowledged product features, but their importance and significance could not be identified. The rationale (and some transcribed comments) for this is as follows:

- *Organisation A* – sees each product as a unit in its entirety and does not differentiate between features therein. When asked to identify product features the response was:
    - *"I don't know how you'd do that as we've got two models"*
    - *"It does what is says on the tin."*
    - Interviewer: *"Can you rank the importance of product features?"* Interviewee: *"Not for the three of them you can't."*
    - Interviewer: "*Do the features impact upon the sales?"* Interviewee: *"No they'd still go with it even if the cost is high…or goes higher."*

- *Organisation B* – given that the vast majority of the business is from product sales made by other manufacturers, this is understandable to some extent, but the Conjoint Analysis could be run on product groups to identify key merchandise being sold. However, given that the company is now manufacturing its own products, such knowledge should arguably be available. This lack of information is not unusual or an issue isolated to *Organisation B* though. Evidence supporting the point that it is a broadly present issue was reported by Quintas (2008) and Durst (2012) who suggested that SMEs are characteristically deficient in systematic knowledge management. Furthermore and allied to resource scarcity, Wong

and Aspinwall (2004) testified that information is often confined to a limited number of people in an organisation, thus limiting its effective use.

For *Organisation B*, this lack of knowledge is partly down to attitude and knowledge of the market in as much as due to market demand, product features are of little interest – what can be made (particularly if it is exclusive) will sell, well in advance of its release as evidenced by the following quotes from the Operations Manager:

- *"If you said a collector was downstairs and I said we were going to make such-and-such, his question is when will it be released, not how much it will cost?"*
- *"Delivery to that guy is more important than cost because he knows it will be about two years so he has time to save*."

- *Organisation C* – sees each product as a unit in its entirety and does not differentiate between features therein. It furthermore does not clearly monitor the products it sells or plans beyond the immediate situation as evidenced from the interview transcription:
  - Interviewer: *"How many products do you sell?"* Interviewee: "*Products? I can't tell you the amount."*
  - Interviewer (clarifying the point): "So you've got standard items…. do you create that special board based on what the suppliers are offering at the time?" Interviewee: *"It depends on what we have most of and what the suppliers are giving you cheaply."*
  - Interviewer (clarifying the point): "Are you just saying well we'll just go along with whatever the suppliers have got when you actually have a new item in mind?" Interviewee: "*We just feel what to do every week by looking at the market as a whole."*

- *Organisation E* – albeit on a larger manufacturing scale to *Organisation A* and *Organisation C*, sees the products as units in their entirety and does not differentiate between features therein.
  - Interviewee: *"I'm struggling to rank the features….in all our products it's just the design of the product in terms of we offer a very innovative approach and we will design for a customer almost anything wanted…..we need to take a more strategic view now."*

There was also limited knowledge of the products and features in general:

- Interviewer: "So if we just name the products you want to analyse...their contribution to turnover is the first point." Interviewee: *"I mean I should know that but I actually don't. I can probably tell you what our product ranges are but in terms of volume and what they are selling at I don't know."*

Critically considering these points and acknowledging that their product features clearly exist, the organisations in question ought to be aware of the feature impacts on products and be in a position to quantify them in product development (in line with Gunasekaran and Ngai, 2005). Failure to do this could potentially result in products with unwanted features, thus increasing costs and potentially losing customers. In the absence of this data, the Conjoint Analysis was not run for these organisations.

Another challenge facing the use of Conjoint Analysis relates to *Organisations F* and *H*, and their perceptions of product features. Whilst it might be anticipated that product features are physical, both organisations identified features that were generic (such as price) yet of great importance to the success of the product. This had not been foreseen yet was more significant in these instances than any other feature so therefore deemed relevant and subsequently utilised in the Conjoint Analysis.

- **Product Feature Identification**

Irrespective of the product feature description, smaller SMEs partaking in the study identified product features more readily than the larger companies. It might be argued that the smaller organisations have fewer products and are therefore more aware of their features. This being the case, the use of Conjoint Analysis as a support tool for the PFS Model is placed in doubt for all SMEs. However, as every organisation in the study is operational and profitable, their products must contain key characteristics of interest to customers that result in sales. Furthermore, some level of product feature understanding must exist within these companies for each product to be devised (it must be stated that the nature of the field *Organisation H* operates in would appear to be customer driven, thus eliminating to some extent the sense that products are offered to the market – the required features and market needs are already known at the point of product design). It may be that the larger SMEs are unaware of such information but it must exist. Lack of this knowledge in the long-term could arguably make survival more challenging – particularly in the face of increasing competition – a point supported by Vargo and Seville (2011).

Whilst the outcomes of the Conjoint Analysis were deemed to be accurate by those organisations utilising the tool, *Organisation G* made particular use of it. Having confirmed the accuracy of the outcomes relative to historical sales data, the organisation utilised the tool as a trial for one of its online product lines. For the first run, the data from the initial Conjoint Analysis was used and suppliers contacted with the view of adjusting the supply chain accordingly. At that point the company owner had some concerns as to why the product offering was receiving a satisfactory number of online views, but sales were considerably lower and not in line with the same product line sales from its premises. A subsequent Conjoint Analysis was run for this line (with all potential variations therein) and after the results were analysed and implemented, subsequent sales rose by over 600% resulting in the Conjoint Analysis being performed for other lines (and ultimately used in line with the PFS Model and Repertory Grid Analysis to determine the entire Christmas range). This point has been made as the results suggest an advantage can come about from their use, thus supporting the benefits of using Conjoint Analysis to support the PFS Model.

Further to this point, it might be argued that the smallest SMEs are almost instinctively aware of the importance of their product features. Whilst this may arguably be the case, as they agreed with the results of the Conjoint Analysis, such knowledge only works to validate its use as a supporting tool – such expert knowledge is thereby substantiating the instrument. The benefits therein can be seen in an example such as *Organisation N*, which is structured around three product elements. The owner acknowledges the fast pace of the business and is keen to employ more individuals to assist expansion and ease some of the management burden. By running the Conjoint Analysis through each of the three product elements, the importance of each product feature dimension is identified as might be anticipated. Additionally, the importance of each feature from the different business elements is identified, illustrated by the Conjoint Analysis outputs that indicate *acupuncture* to be the lowest scoring feature from the entire set of results. Given the limited time resource (and possibly financial reward) for providing this feature, it could arguably be removed from the product offering, possibly along with the other elements of its product set such that the organisation can concentrate on the other products to maximise output.

- **Conjoint Analysis Implementation**

From the standpoint of Conjoint Analysis implementation, there appears to be a general picture that can be identified across the sample SMEs. Whilst there is no clear data output correlation between all companies partaking in the study, the smaller organisations are, on the whole, more open to change and implementation of the models. Whilst only *Organisation G* practically implemented the given models, it has done so in conjunction with some very large suppliers operating in a highly competitive market.

Whilst such changes may not be possible for all SMEs, the fact that it has been operationalised for this one company illustrates the possibilities that exist. It also illustrates the fact that large suppliers are potentially more flexible than some participating SMEs believe. Further examples of similar (but not yet implemented) attitudes exist in the cases of *Organisations K, N* and *O* who appear keen to utilise the data for the future of business improvement and developments. The larger companies such as *Organisation F* and *H* are happy to acknowledge the findings for their accuracy but due to their size are uninterested at the present time in their implementation.

This is an important point for this thesis – particularly with regards its contribution. Such findings tend to indicate that whilst relevant for all sample SMEs, the models are most useful to the smaller companies who are able to respond quickly to market changes and implement such changes at reasonably short notice. This might be particularly relevant for organisations dealing with more bespoke products. This being the case, the models would be clearly applicable to *Organisation F* when they begin manufacture of more bespoke products on a larger scale.

It is therefore being argued that the Conjoint Analysis is most definitely a suitable support tool for the PFS Model. Organisations failing to provide relevant data for its use might benefit from considering the matter in more depth.

6.4 Supplier Management

As discussed in the literature review and theoretical framework chapters, supply chain management plays an important role in agile supply chains and operates in the forms of reliance (Johnson, 1999), contracts (Handfield and Bechtel, 2002), information sharing (Li *et al.,* 2006), relationship stability (Caloffi *et al.,* 2015), trust (Miquel-Romero, 2014), loyalty (Shaalan *et al*., 2013), and transparency (Doorey, 2011). For this research, the Repertory Grid Analysis supports the PFS Model in consideration of supplier management.

Before reflecting upon the Repertory Grid Analysis results, it is important to acknowledge that (similarly to the Conjoint Analysis) organisations *A, B, C*, and *E* were unable to provide data to run through it. In each instance the organisations believed their suppliers to be unwilling to engage in active relationships, supply chain improvement and the agility therein, effectively seeing themselves as having to operate at the behest of suppliers. Contradicting this point, the PFS Model identified each organisation as foreseeing improved future supplier relationships (that they agreed were accurate). The conclusion at

this point is that these organisations have no real intention of progressing matters in this area and are fundamentally satisfied with the present situation.

Whilst acknowledging that the different approaches to supplier management between organisations *A, B, C*, *E* and the other companies is largely proactivity, this cannot be the sole reason for the different organisational outcomes. Proactivity in itself cannot explain why *Organisation H* has a turnover of £1.6 million compared to *Organisation K* at around £100,000. The levels of investment, type of business, number of employees and owner interests are just some of the other factors that need to be taken into account. Yet there is presently a distinction between the larger and smaller SMEs – namely output volume. The larger SMEs operate along more mass manufacturing lines compared to their smaller counterparts, thus providing the throughput and demand to arguably induce suppliers into closer working relationships to ensure product development and effective supplier management. This argument is beneficial to SMEs with large outputs and would therefore logically suggest that the use of the PFS Model and the supporting Repertory Grid Analysis are ideally suited to such situations. In acknowledging this, the argument potentially eliminates benefits of the models for the smaller companies.

Yet the benefits of using the said models are not restricted to the larger companies - the smaller organisations *G, N* and *O* do not operate with such large outputs yet positively interact with suppliers to achieve their goals. *Organisation G* is arguably the most proactive company in the data sample and positively implemented all elements of the model outcomes under consideration, providing it with significant benefits in so doing. By comparison *Organisation N* has possibly the most interesting take on supplier interactions as prior to purchasing new supplies and equipment the owner investigates market prices from various sources, following which the preferred supplier is effectively made an offer. Should this not be accepted then negotiations follow to maximise the purchasing position – extra purchases are made provided the unit costs meet requirements and expectations. *Organisation O* holds a slightly different view, historically changing suppliers to achieve maximum returns, illustrating little loyalty in the process. With an enhanced feeling of responsibility, such practices have altered in the last ten years yet the company is still open to changing suppliers. At the last point of contact with the company, serious considerations were taking place regarding switching suppliers to Eastern Europe due to a 50% saving, yet there is still the clear requirement of a supplier relationship.

When considering *Organisations K* and *L*, it is reasonable to suggest they operate in niche markets. Whilst both organisations foresee little potential market change in the future, they both purchase supplies based upon supplier-set standard prices, and until their outputs increase substantially there appears to be little alternative. Both organisations benefitted from the Conjoint and Repertory Grid Analyses though, an example being illustrated by *Organisation L* who can now see a clear demarcation

between the products and features being offered. Having reflected upon the results, the company began considering changing its key product offerings based upon the three most popular features only (in a similar way to *Organisation G)*. Should such changes come about, other product options would always be available by special request (with an appropriate pricing structure to match). Such changes would result in the elimination of raw material storage space and lowered costs for the less popular products as well as the potential to purchase and store raw materials for the more popular products in larger quantities, thus benefitting from economies of scale (albeit at supplier-set prices). In each case, the Repertory Grid Analysis (aligned to the Conjoint Analysis) is indicating levels of attractiveness that if adopted would impact upon supplier management and support the PFS Model results (aligning with Sharifi *et al.,* 2009).

Having looked at general aspects of supplier management in line with the PFS and Repertory Grid Analysis models, more detailed consideration can be made of the data findings.

The data provided for the Repertory Grid Analysis centred upon internal and external needs regarding supplier management (as considered in the Theoretical Framework chapter). Whilst the individual organisational output data was presented in the Findings chapter, an amalgamated Repertory Grid Analysis internal factor element summary for all organisations to establish trends between participating SMEs is illustrated in Table 6. 9 (the options for which are low, medium or high as explained in the Theoretical Framework chapter).

Table 6. 9 – Summary of Relative Importance of Internal Factor Findings (Low/Medium/High) for Repertory Grid Analysis (Author)

	Cost	Time	Quality	Performance	Innovation	Flexibility	Service	Market	Proportional % of Low, Medium, High Totals
Total Low	34%	11%	13%	6%	54%	15%	1%	7%	19%
Total Medium	26%	68%	18%	3%	21%	39%	13%	15%	27%
Total High	39%	19%	64%	74%	24%	34%	73%	76%	54%

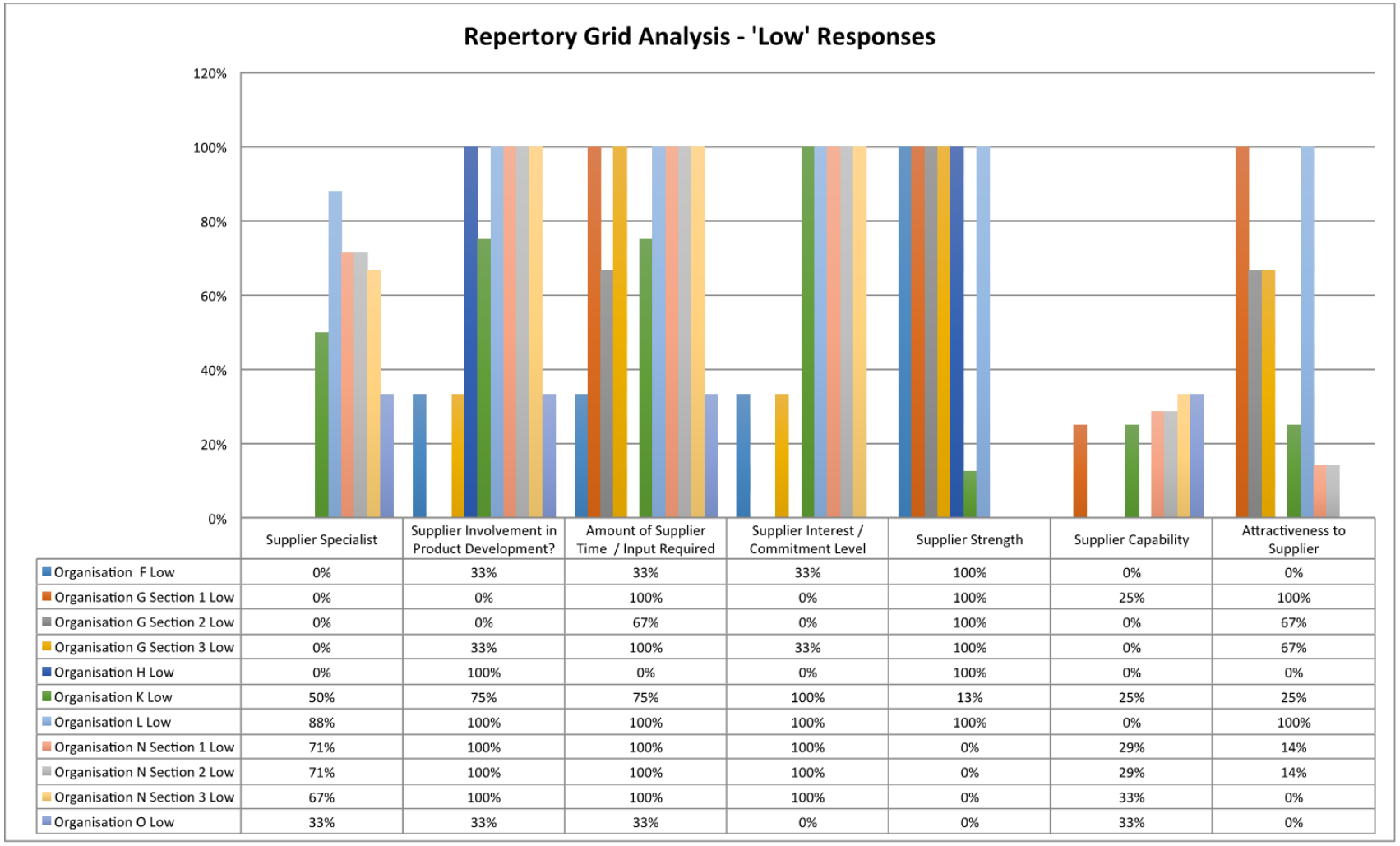
The findings illustrate the significance of the *internal* data factors as proportionally the sample group has *high* rates of interest for these elements used in the Repertory Grid Analysis. This is not the case in every event (such as *innovation* for example where they appear to rely upon product innovations introduced by suppliers) but it is predominantly the situation.

The *external* findings (again based upon the low, medium and high element responses) are illustrated in Table 6. 10.

Table 6. 10 – Summary of Relative Importance of External Factor Findings (Low/Medium/High) for Repertory Grid Analysis (Author)

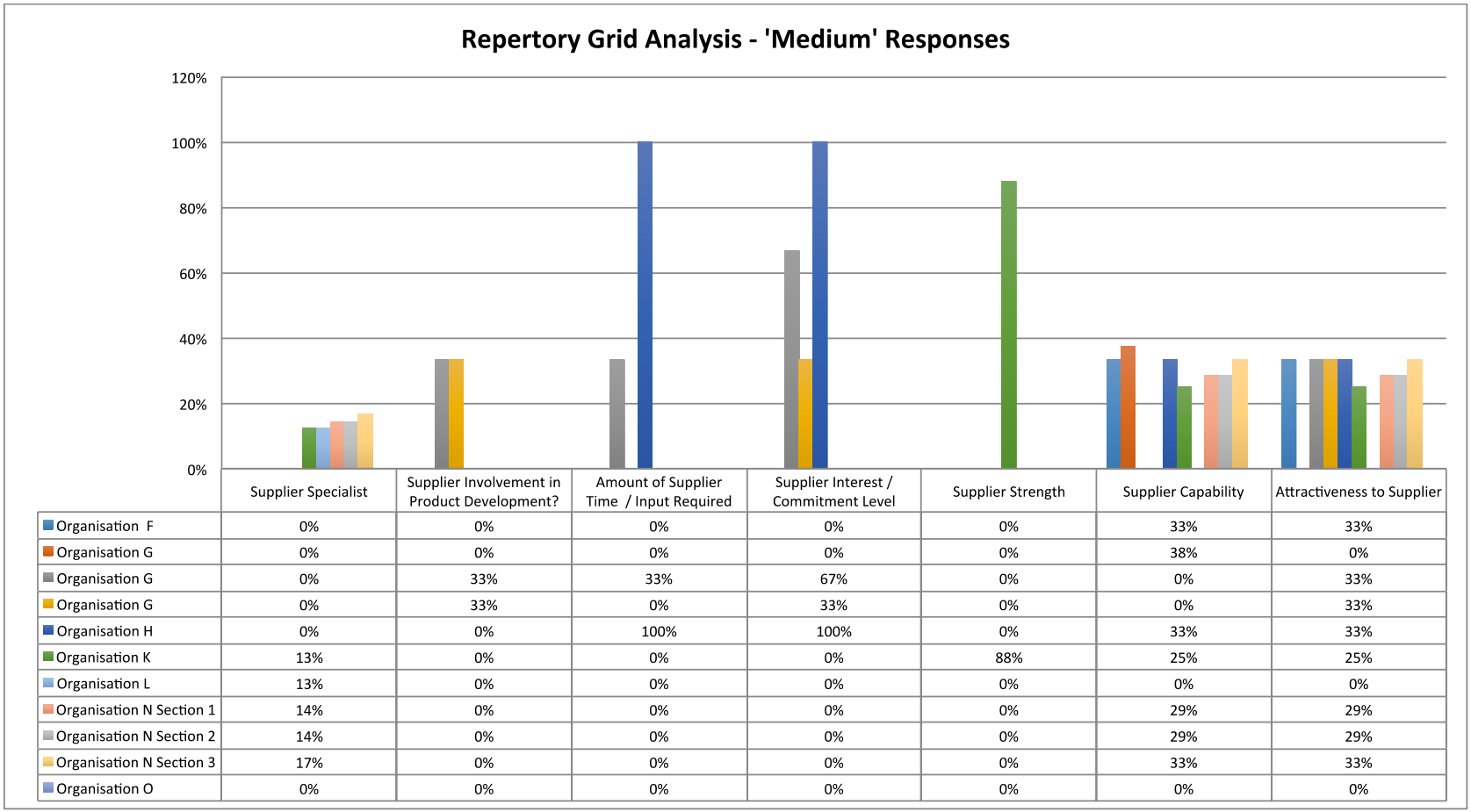
	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required	Supplier Interest / Commitment Level	Supplier Strength	Supplier Capability	Attractiveness to Supplier	Proportional % of Low, Medium, High Totals
Total Low	35%	61%	73%	52%	56%	16%	35%	47%
Total Medium	6%	6%	12%	18%	8%	20%	23%	13%
Total High	59%	33%	14%	30%	36%	64%	42%	40%

The external factor findings relative to one another are illustrated in Figure 6. 18, Figure 6. 19 and Figure 6. 20. The data is presented in this way to illustrate the significant aspects of supplier management outputs.



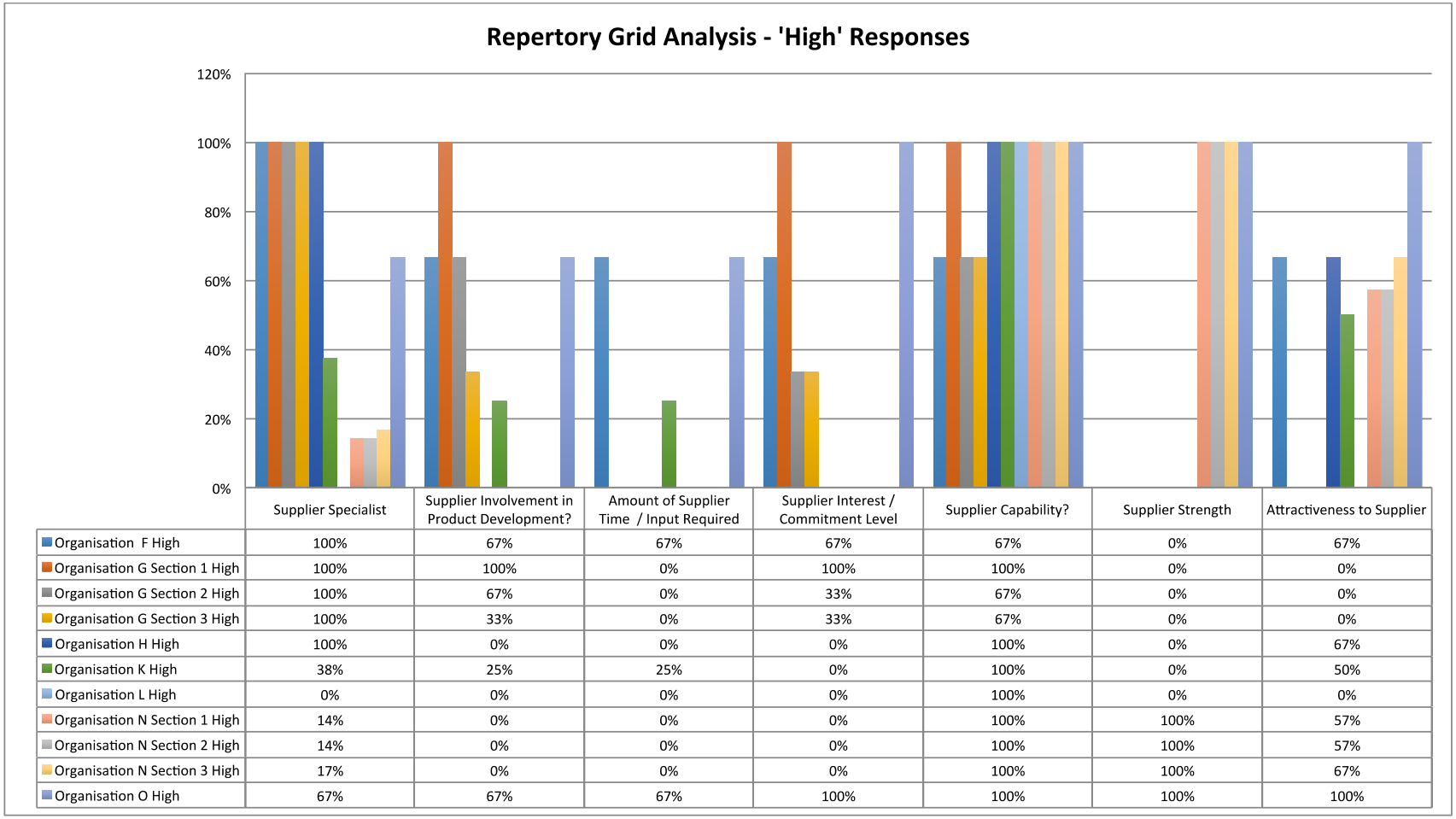
	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required	Supplier Interest / Commitment Level	Supplier Strength	Supplier Capability	Attractiveness to Supplier
Organisation F Low	0%	33%	33%	33%	100%	0%	0%
Organisation G Section 1 Low	0%	0%	100%	0%	100%	25%	100%
Organisation G Section 2 Low	0%	0%	67%	0%	100%	0%	67%
Organisation G Section 3 Low	0%	33%	100%	33%	100%	0%	67%
Organisation H Low	0%	100%	0%	0%	100%	0%	0%
Organisation K Low	50%	75%	75%	100%	13%	25%	25%
Organisation L Low	88%	100%	100%	100%	100%	0%	100%
Organisation N Section 1 Low	71%	100%	100%	100%	0%	29%	14%
Organisation N Section 2 Low	71%	100%	100%	100%	0%	29%	14%
Organisation N Section 3 Low	67%	100%	100%	100%	0%	33%	0%
Organisation O Low	33%	33%	33%	0%	0%	33%	0%

Figure 6. 18 – Repertory Grid Analysis 'Low' Responses (Author)



	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required	Supplier Interest / Commitment Level	Supplier Strength	Supplier Capability	Attractiveness to Supplier
Organisation F	0%	0%	0%	0%	0%	33%	33%
Organisation G	0%	0%	0%	0%	0%	38%	0%
Organisation G	0%	33%	33%	67%	0%	0%	33%
Organisation G	0%	33%	0%	33%	0%	0%	33%
Organisation H	0%	0%	100%	100%	0%	33%	33%
Organisation K	13%	0%	0%	0%	88%	25%	25%
Organisation L	13%	0%	0%	0%	0%	0%	0%
Organisation N Section 1	14%	0%	0%	0%	0%	29%	29%
Organisation N Section 2	14%	0%	0%	0%	0%	29%	29%
Organisation N Section 3	17%	0%	0%	0%	0%	33%	33%
Organisation O	0%	0%	0%	0%	0%	0%	0%

Figure 6. 19 – Repertory Grid Analysis 'Medium' Responses (Author)



	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required	Supplier Interest / Commitment Level	Supplier Capability?	Supplier Strength	Attractiveness to Supplier
Organisation F High	100%	67%	67%	67%	67%	0%	67%
Organisation G Section 1 High	100%	100%	0%	100%	100%	0%	0%
Organisation G Section 2 High	100%	67%	0%	33%	67%	0%	0%
Organisation G Section 3 High	100%	33%	0%	33%	67%	0%	0%
Organisation H High	100%	0%	0%	0%	100%	0%	67%
Organisation K High	38%	25%	25%	0%	100%	0%	50%
Organisation L High	0%	0%	0%	0%	100%	0%	0%
Organisation N Section 1 High	14%	0%	0%	0%	100%	100%	57%
Organisation N Section 2 High	14%	0%	0%	0%	100%	100%	57%
Organisation N Section 3 High	17%	0%	0%	0%	100%	100%	67%
Organisation O High	67%	67%	67%	100%	100%	100%	100%

Figure 6. 20 – Repertory Grid Analysis 'High' Responses (Author)

Whilst acknowledging the differences between the internal and external results, the proportion of the data falling into the *low, medium* or *high* categories do not align or correlate (Illustrated in the aggregated totals shown in Figure 6. 21). Whereas the *high* factors provide the highest ranking for the *internal* aggregated results, the *low* factors provide the highest ranking for the *external* aggregated results. In both cases the *medium* results option was the least important.

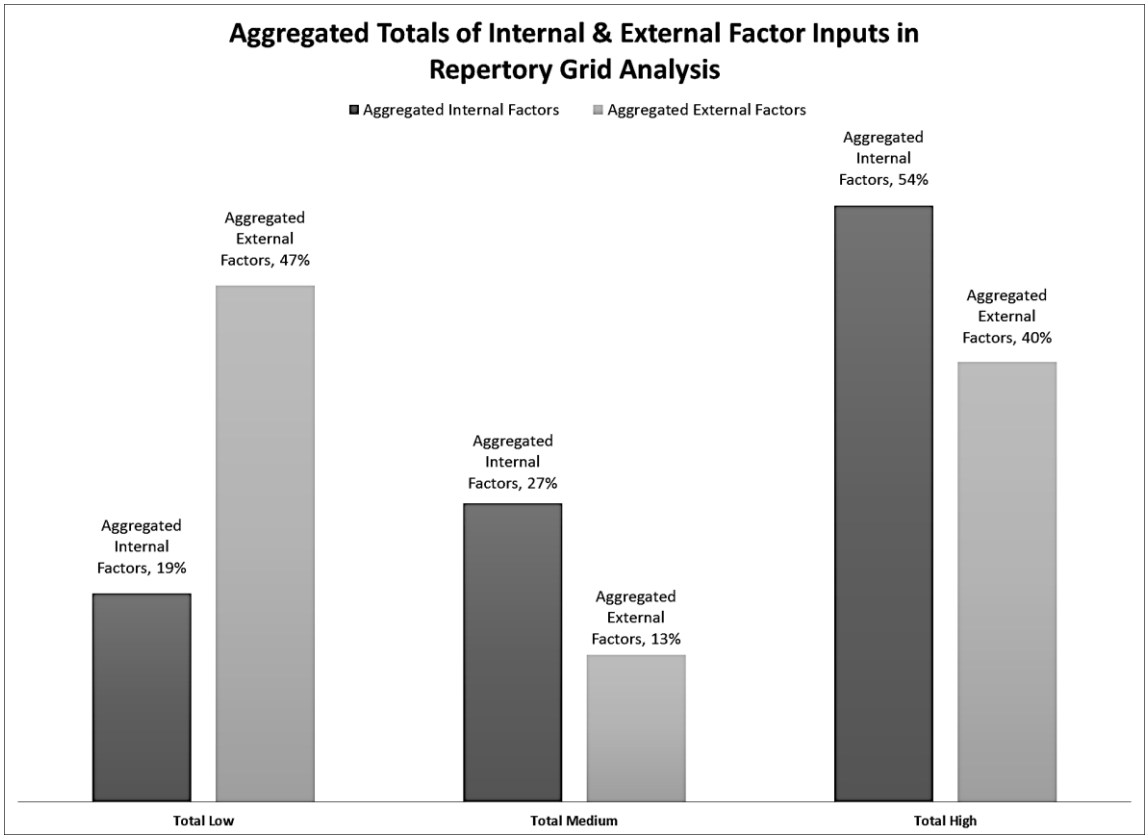


Figure 6. 21 – Aggregated Totals of Internal and External Factor Inputs in Repertory Grid Analysis (Author)

The PFS Model results in the Findings chapter highlighted *Supplier and Supply Chain* issues to be of most concern for SMEs. The *external* data (Table 6. 10, page 255) supports this, emphasising 59% of SMEs need to work with specialist suppliers, yet only 33% anticipate a high level of supplier involvement and only a further 30% anticipate a high level of supplier commitment in product development. Despite this, 64% consider their suppliers to have a high degree of ability and are therefore capable of assisting and benefitting from such product developments.

A point of general note arises here regarding some of the case study organisations who showed little appreciation or interest in their supply chains, as evidenced from the qualitative data. Findings suggest a significant reason for this is that as the companies in question are small and have low

impact upon their supply chains, they believe there to be little point in investing time interacting with them. Having provided the PFS Model and subsequently improved their understanding of the importance of agility within their supply chains and how they can strategically benefit from proactivity therein, the objective and structure to implement such changes is now present. There is furthermore evidence of interest in these companies utilising the PFS Model to develop agility in their supply chains in the future.

Alongside this point, this low levels of supplier involvement in product development might also be explained by the simple nature of the fact that the suppliers are working here with SMEs who they believe by their very nature are potentially too small to make investments in new products worthwhile. Subsequently, 47% of the overall data set accounts for *low* levels of anticipated work with suppliers. However, a key point to note here is that a number of the sample SMEs have a turnover in the millions (sterling) – rationally sufficient to potentially interest suppliers in the long-term, and therefore sufficient to suggest the development of supplier relationships and agile supply chains.

With reference to *supplier interest or commitment level* data, the highest commitment appears from *Organisations F* (the SME with the largest turnover in the sample) and *G*. Similar commitment level responses align the remaining organisational responses with each other. Arguably, the high results for *Organisation F* are due to the high levels of turnover, making it worthwhile for suppliers to work with them in product development and manufacturing. Those organisations with relatively low turnovers have acknowledged no supplier interest or commitment at all (despite the market remaining attractive to the supplier). Despite this, 42% of respondents believe suppliers have a *high* level of interest in dealing with them. The anomaly and challenge lies in the fact that suppliers want to supply but are less interested in investing in product development and relationships.

Whilst this may not be an ideal situation, from the agility standpoint there are a number of positive arguments that Repertory Grid Analysis can offer. Significantly, the SMEs acknowledge the specialism (and therefore knowledge) and capability of suppliers. Importantly, given the fact that 42% of respondents believe a high level of supplier interest exists in terms of supplying, there are rationally grounds to suggest closer working relationships be developed as suppliers will not want to lose future business (in line with Archer *et al.,* 2008).

For those organisations providing data for the Repertory Grid Analysis, the outputs clearly present results indicating the levels of interest in product development aligned to potential suppliers. These results have been deemed accurate and in the case of *Organisation G*, beneficial once implemented.

Having considered the PFS Model and Repertory Grid Analysis supportive outputs, it is important to refer back to points considered in the literature review chapter regarding supplier management and

growth. It was argued therein that the supply chain should be seen as a whole (Fawcett and Waller, 2014) and not considered from an internal and external perspective (as highlighted by Rich and Hines, 1997). It was also contended that cooperation between supply chain members is fundamental to the success of an agile supply chain (Wood and Brewster, 2005), especially as levels of uncertainty rise (Pilbeam *et al.,* 2012) as such relationships afford greater predictability and stability for those involved (Christopher, 1998; Lambert *et al.,* 1998). Furthermore, Christopher (2000), Christopher and Towill (2001), Fantazy *et al.,* (2009) and Hallavo (2015) argued that organisations operating alone cannot build agile supply chains that assimilate and build relationships meeting customer expectations.

In its support of the PFS Model, the Repertory Grid Analysis has drawn together the internal and external aspects of supply chain considerations in one output. In so doing, the relative importance of these factors have been considered in line with the findings data. This data confirms that SMEs require supplier commitment (in line with Wood and Brewster, 2005) and that without it their ability to create agility within their supply chains is not possible (in line with Christopher and Towill, 2001; Fantazy *et al.,* 2009; Hallavo 2015).

Yet the Repertory Grid Analysis goes one step further – working together with the Conjoint Analysis, it classifies the level of organisational attractiveness to product and product feature developments for an SME and its potential supply chain partners. The Repertory Grid Analysis as used herein identifies a buyer-seller relationship to bring about intended outcomes (in line with Mortensen *et al.,* 2008) to ultimately meet the buyer's needs (in line with Handfield *et al.,* 2000). Through such relationships, SMEs limit expenditure and gain financially as every element of the supply chain is likely to be proactive and require low levels of supplier management (in line with Cordon and Vollmann, 2002; Christiansen and Maltz, 2002; Ellegaard and Ritter, 2006). Furthermore, through the awareness of such strengths and weaknesses, SMEs are positioned to consider potential strategies (in line with Ismail *et al.,* 2011).

6.5 Reflection and Summary

Having considered the data outputs, it is being strongly argued that both the Conjoint and Repertory Grid Analyses models hold suitable supporting roles for the PFS Model. Whilst the Conjoint Analysis identifies relevant product component features and the Repertory Grid Analysis specifically identifies the overall attractiveness for an SME to be involved with a given product, the PFS Model highlights potential barriers, vulnerabilities, market exposure concerns and factors that might affect a product's success. In so doing an appropriate level of research is provided. Clearly, each model works independently of the others, but by aligning their outputs, a clearer operating picture is provided of the present functioning state of an SME such that the relative strengths and weaknesses may be addressed to develop an agile supply chain.

The amalgamated outputs illustrate that smaller SMEs face more challenging situations than their larger counterparts (which might be expected due to their lack of resources and the inappropriateness and scarcity of research available to help them develop (Herbane, 2010), resulting in SMEs existing in a state of denial regarding the uncertainties faced (Pollard and Hotho, 2006)), rationally leading to the argument that larger SMEs are likely to find it easier to develop agile supply chains after use of the PFS and supporting models.

Contrary to this point, the smaller SMEs on the whole found it easier to provide the necessary information for use in the models and were more aware of their supply chain interactions and relationships than their larger counterparts. Their small stature also enables them to manoeuvre around the systems put in place by suppliers (that should arguably be non-negotiable positions).

These points are supported by the qualitative data derived from the questionnaire-interviews. The attitudinal approach of smaller SMEs to operations alongside their production formats and levels of adaptability make them naturally responsive. When aligned with the PFS Model, Conjoint and Repertory Grid Analyses results, their natural responsiveness provides the flexibility and wherewithal to adopt an agile approach to supply chain development. It is therefore being argued that whilst the models under consideration hold value for all SMEs, it is the smaller companies that appear placed to benefit the most from their use. If nothing else, the tools position these businesses in states of strategic readiness (in line with Ismail *et al.,* 2011) whereby they think and strategically plan in such a way that new markets can be developed (in line with Toulova *et al.,* 2015). Such strategic considerations help develop longer-term partnerships that can develop together and create agility (in line with Contractor and Lorange, 1988; Eisenhardt and Schoonhoven, 1996; Hoffmann and Scholsser, 2001).

This leads to a final point for consideration that could potentially be considered in future research. In accepting that the smaller SMEs are most suitable for agility and agile supply chain development,

there must logically be a point above which this level of being *small* ends as an organisation grows. The challenge such companies therefore face is not just one of sustainability – it is one of maintaining the attitudinal and operational perspectives of being small whilst growing and remaining agile – two factors that do not appear to easily fit together from this research.

7.0 Roadmaps

At this stage in the thesis the PFS Model has been developed and tested at case study organisations. This fulfils a role in itself, but there are benefits to be gained beyond the model by developing a step-by-step programme to assist in the drive for SME agility. In so doing, the final stage of the agility development process is addressed in line with Ismail *et al.,* (2011). Such a process is supported historically by writers such as Sharifi and Zhang (1999) in the *conceptual model of agility* in adopting a similar approach to practical self-assessment tools.

Such an implementation proposition addresses points made in the Literature Review by Sharifi and Zhang (1999) who believed agility implementation to have only been considered from an idealistic standpoint, and Zhang and Sharifi (2000) who argued realistic tools for agility implementation were unclear and lacking. Beyond this, Vázquez-Bustelo *et al.*, (2007) suggested the agility concept to have been encouraged without suitable implementation tools, and Zhang (2011) argued this problem continues as the method for building organisational agility is not fully clear. Irrespective of the historical position, having looked at methodologies from literature and data gathered from the case studies, it makes sense to map the agility journey and assist SMEs in their development task (in line with Ismail *et al.,* 2011).

Resultantly, this chapter addresses the need for an agile supply chain implementation tool within SMEs. It does so by illustrating a path to required destinations by developing a step-by-step roadmap initiating from the PFS Model results. The data source supporting the creation of the roadmaps comes from references discussed earlier in the thesis (for example The Agility Road Map Model (Ismail *et al.,* 2006) and EFQM) and data derived from the questionnaire-interviews (in line with Lee *et al*., 2012).

This tool is not definitive or prescriptive but generic (in a similar way to tools such as the EFQM) and in principle applicable to all SMEs. It is not presented as a means of validating the PFS or other models. Moreover, it is a proposition to fulfil the final stage of the agility development process and assist future research, outlining factors for consideration (in line with Ismail *et al.,* 2011), and addressing the shortage of implementation tools identified by Zhang and Sharifi (2000), Vázquez-Bustelo *et al.*, (2007) and Zhang (2011). Whilst generic, it can be made more bespoke but this requires time with every participating SME. For the purposes herein, this generalised design has been adopted to illustrate the principle behind the format.

7.1 Linking the PFS Model to the Roadmaps

The individual roadmaps are modular and presented in this chapter from section 7.3.1 (page 275). Whilst each roadmap affords its own merit, ranked order utilisation based upon PFS Model outputs provides an actionable route to SME agility. To initiate this, the PFS Model outputs are applied to a bridging process, facilitating roadmap selection and application (illustrated in Figure 7. 1).

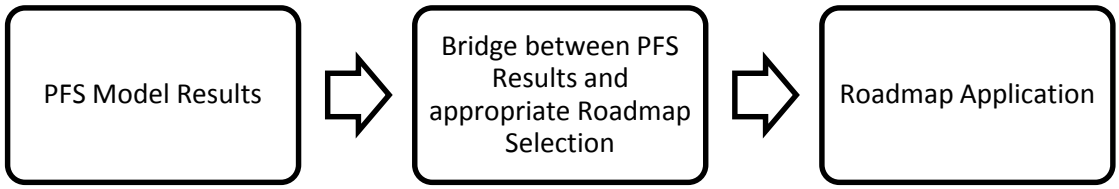


Figure 7. 1 - Overview of Workings of Roadmap Tool (Author)

The bridging process ranks the *Percentage Deviance from Mid-Point* from the PFS Model results, and provides a corresponding order in which to use the roadmap chain to subsequently implement and achieve supply chain agility (illustrated in Figure 7. 2). In so doing, the process develops the PFS Model into a practical implementation methodology, assisting SMEs in making the strategic decisions required to realise supply chain agility.

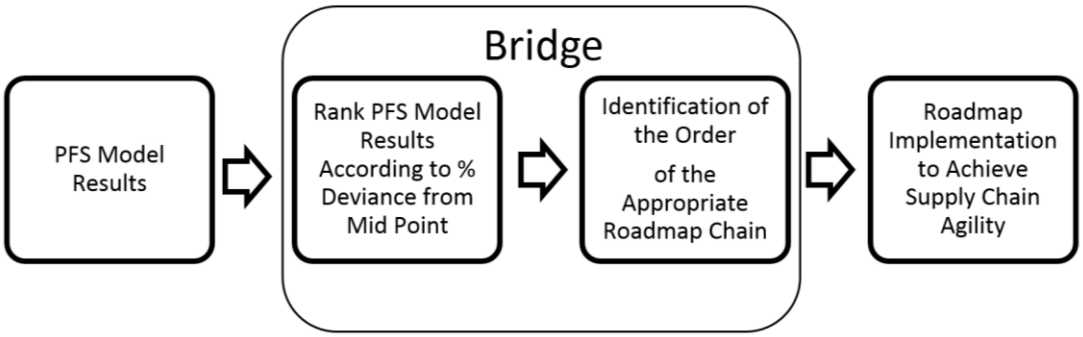


Figure 7. 2 – Appropriate Roadmap Chain Selection through PFS Model Results (Author)

This methodology therefore provides an informed priority overview of the roadmap process, providing both a proposition to pave the way for practitioners and a thinking model for academics to take into the field of research and develop further.

7.2 Roadmap Development

Initial roadmap diagrams were developed in the form of flow charts illustrating all interactions on a single page (illustrated in Figure 7. 3). Whilst it is believed these diagrams were effective in their own right, they were found in examination to be somehow complicated, requiring care and attention to maximise their benefit.

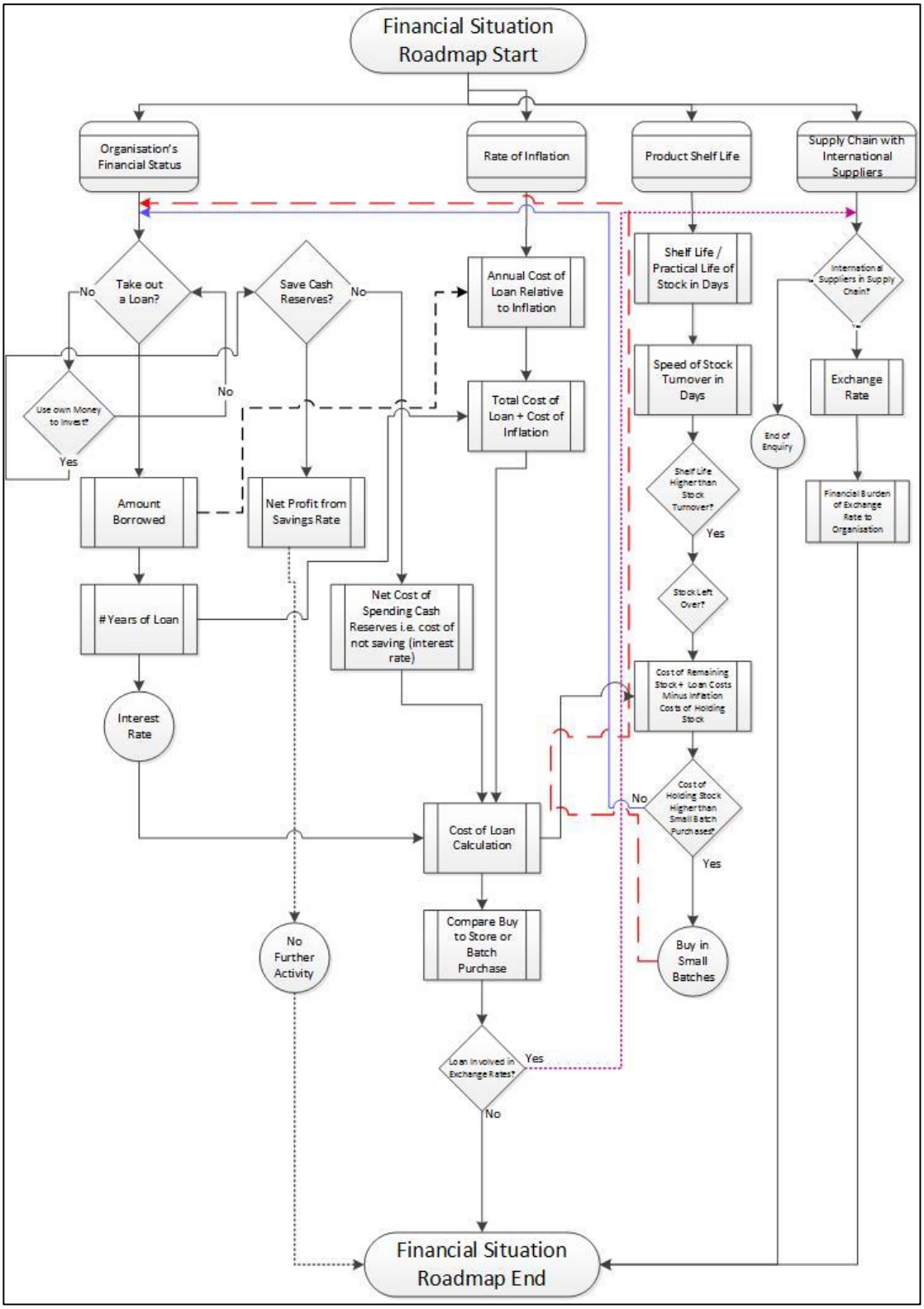


Figure 7. 3 – Example of Previous Version of Single-Page Roadmap (Author)

A simpler format was therefore required and the redesign was developed utilising IDEF0 methodology, as considered in the theoretical framework chapter. IDEF0 models consist of three elements - graphic diagrams, accompanying text and a glossary, as well as boxes, arrows, interconnections and connected relationships. The four key mechanisms interconnecting the boxes and activities (Akasah *et al.,* 2010) are:

- *Input* – any aspect of the model requiring processing to provide an output
- *Output* – the outcome of an activity
- *Control* – a circumstance or state controlling an activity
- *Mechanism* – the tool needed to change an input to an output within an activity

This is illustrated in Figure 7. 4:

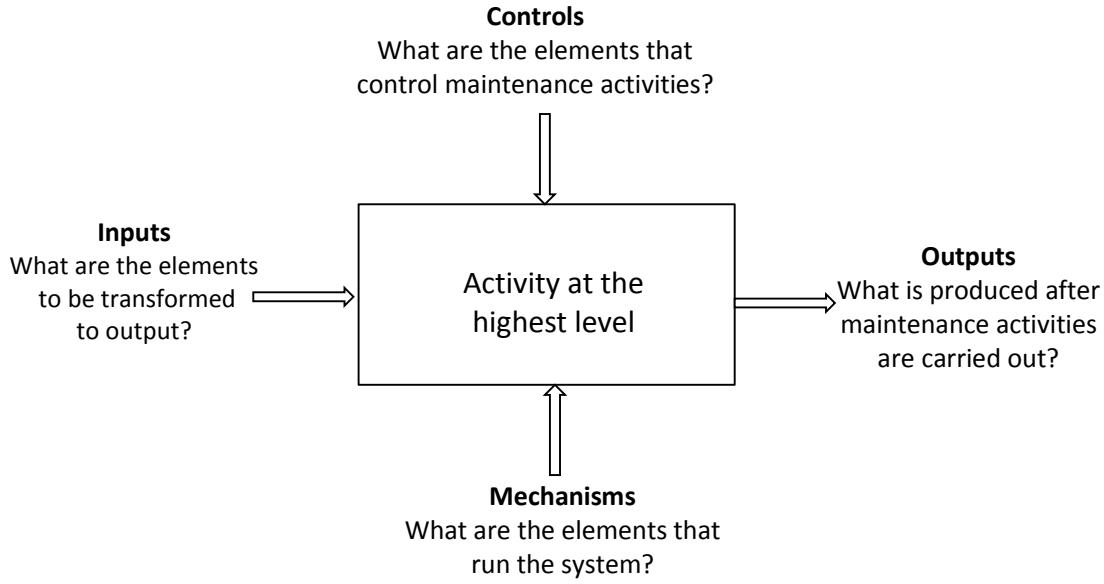


Figure 7. 4 – Basic example of IDEF0 Model (adapted from Laguna and Marklund, 2013, pp. 138)

When multi-level IDEF0 models are built they cross-reference and interrelate, demonstrating parent and child relationships. The top level (parent) diagrams present a generalised overview of a situation. Each successive (child) diagram provides more detail. The boxes denote the key roles of a

topic and are broken down into more detailed (child) diagrams until all necessary information is provided for a given task (Illustrated in Figure 7. 5). It is important to note again that the roadmaps herein are generic and do not contain every possible option or diagram for every SME.

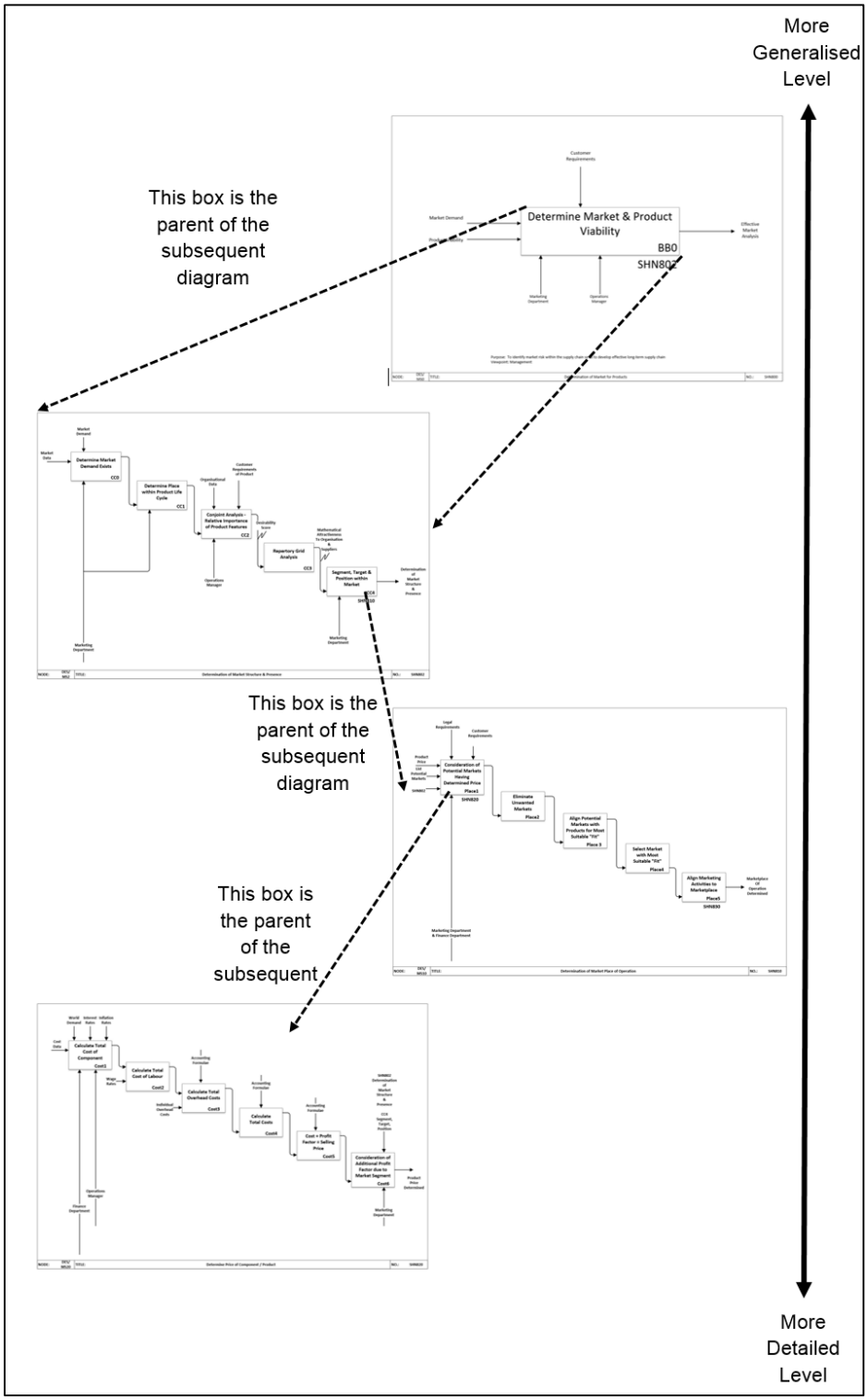


Figure 7. 5 – Decomposition Overview of the IDEF0 Diagrams (Author)

These relationships are illustrated for each roadmap chain herein by hierarchy diagrams.

7.3 The PFS Model Areas of Consideration and Roadmaps

In principle, each PFS Model area could have its own roadmap, but this results in a substantial number of roadmap diagrams that complicate the methodology. Instead, the roadmaps have been developed as a series of amalgamated areas, providing a broader and less complex perspective of the processes involved. Whilst outside the bounds of this thesis, additional detail could be built into further *child* roadmaps if required. In not illustrating every potential iteration, the methodology is similar to those such as the Balanced Score Card and EFQM. Aligned to this, subjective issues affect the roadmap model. Accordingly its accuracy and effectiveness are dependent upon the precision of the data provided by the SME and entered into the PFS Model.

In developing the roadmaps, all areas within the PFS Model have been considered. The area amalgamations and subsequent roadmap formats are presented in Table 7. 1.

Table 7. 1 - PFS Model Results and Subsequent Roadmap Amalgamations(Author)

PFS Results Area	Subsequent Roadmaps
Market Risk	Market Risk & Product
Product	
Financial Situation of the Organisation	Financial Situation
Business Environment	Vulnerabilities and Business Environment
Vulnerabilities	
Relationship with Suppliers	Suppliers and the Supply Chain
Suppliers and the Future	
Suppliers and the Supply Chain	

The use of these amalgamated areas can be illustrated in an example using *Organisation G*'s data - the only organisation to have implemented the PFS Model. The process was checked with the company and the outputs confirmed as being relevant, valid and a sound approach to implementation. The procedure begins with *Organisation G*'s PFS Model results, illustrated in Figure 7. 6 and Table 7. 2.

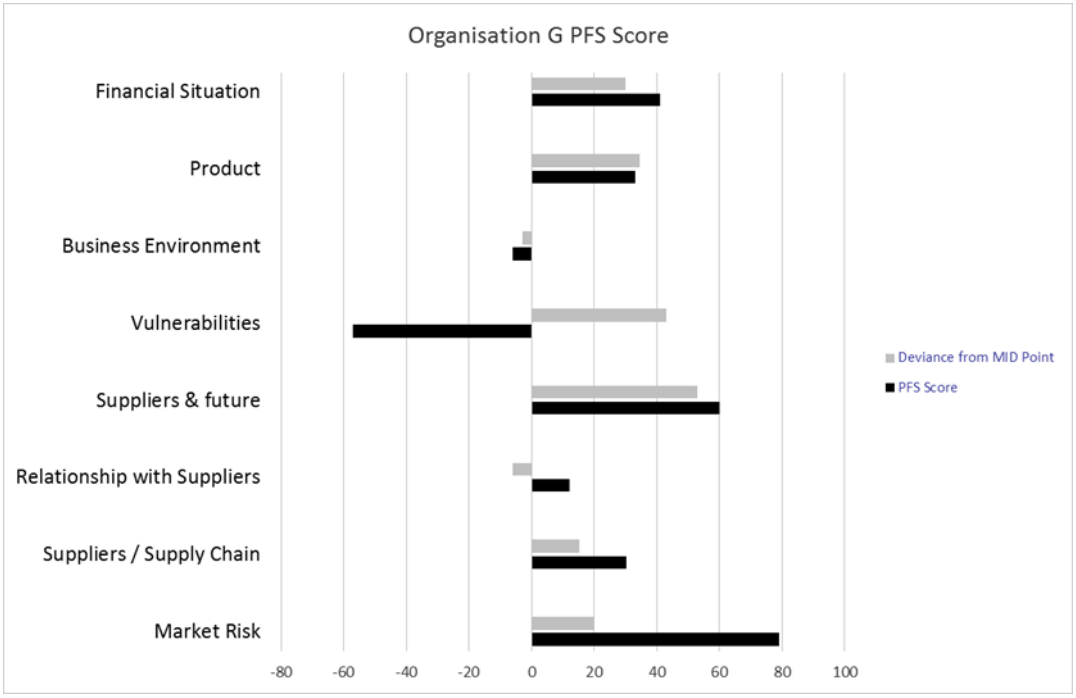


Figure 7. 6 - Organisation G PFS Model Score (Author)

Table 7. 2 - Organisation G PFS Model Data Scores (Author)

QUESTIONNAIRE AREA	Organisation G PFS SCORE	POTENTIAL SPREAD			Company's % DEVIANCE from MID Point	Company's DEVIANCE from MID Point
		MIN	MID POINT	MAX		
Market Risk	79	7	59	111	134%	20
Suppliers / Supply Chain	30.3	-18	15	48	202%	15.3
Relationship with Suppliers	12	-14	18	50	67%	-6
Suppliers & future	60	-106	7	120	857%	53
Vulnerabilities	-57	-215	-100	15	57%	43
Business Environment	-6	-18	-3	12	200%	-3
Product	33	-120	-1.5	117	-2200%	34.5
Financial Situation	41	-31	11	53	373%	30

The *Percentage Deviance from Mid-Point* score data (which balances out weightings between the different Questionnaire Areas) from Table 7. 2 undergoes the amalgamating bridging process (illustrated in Table 7. 1). An example of this is the amalgamation of the *Market Risk and Product* scores. The sum adding these together is (134% +(-2200%) = -2066%). When all amalgamations are complete in line with Table 7. 1, they are ranked in order of priority. This is the priority order in which the roadmaps will be used. The area with the lowest percentage output has the highest actionable priority, and the area with the highest percentage output the lowest (illustrated in Table 7. 3).

Table 7. 3 - Ranked Areas for Consideration for Organisation G (Author)

Questionnaire Area	Organisation's % Deviance from MID Point	Area for Consideration Priority Ranking Order
Market Risk and Product	134% + (-2200%) = -2066%	1
Vulnerabilities and Business Environment	57% + 200% = 257%	2
Financial Situation	373%	3
Relationship with Suppliers, Suppliers and the Future, Suppliers and the Supply Chain	67% + 857% + 202% = 1126%	4

For *Organisation G*, the *Market Risk and Product* is the priority area for consideration. For this, the initiating roadmap diagram is SHN800 (illustrated in Figure 7. 8, Page 277), following which all successive roadmaps should be followed (illustrated in Table 7. 5 and Hierarchy Diagram 7. 1, page 275).

The roadmap ranking (and subsequent roadmap numbers) for all *Organisation G* areas are illustrated in Table 7. 4.

Table 7. 4 – Order in Which Roadmap Work will be Undertaken (Author)

Questionnaire Area	Organisation's % Deviance from MID Point	Area for Consideration Priority Ranking Order	Roadmap Node	Roadmap Description	Roadmap Diagram Number	Roadmap Diagram Number
Market Risk & Product	134% + (-2200%) = -2066%	1	DES/MS0	Determination of Market Products Roadmap	SHN800	Figure 7. 8 Page 277
Vulnerabilities and Business Environment	57% + 200% = 257%	2	DES/VULN0	Avoiding Vulnerabilities Roadmap	SHN600	Figure 7. 20 Page 303
Financial Situation	373%	3	DES/FIN0	Financial Situation Roadmap	SHN400	Figure 7. 13 Page 288
Relationship with Suppliers, Suppliers and the Future, Suppliers and the Supply Chain	67% + 857% + 202% = 1126%	4	DES/SC0	Supply Chain Roadmap Overview Roadmap	SHN200	Figure 7. 31 Page 327

In following this roadmap chain, the company is presented with a pathway to agility (aligned to the *PFS Model*), tailored to its specific characteristics, illustrated in Figure 7. 7.

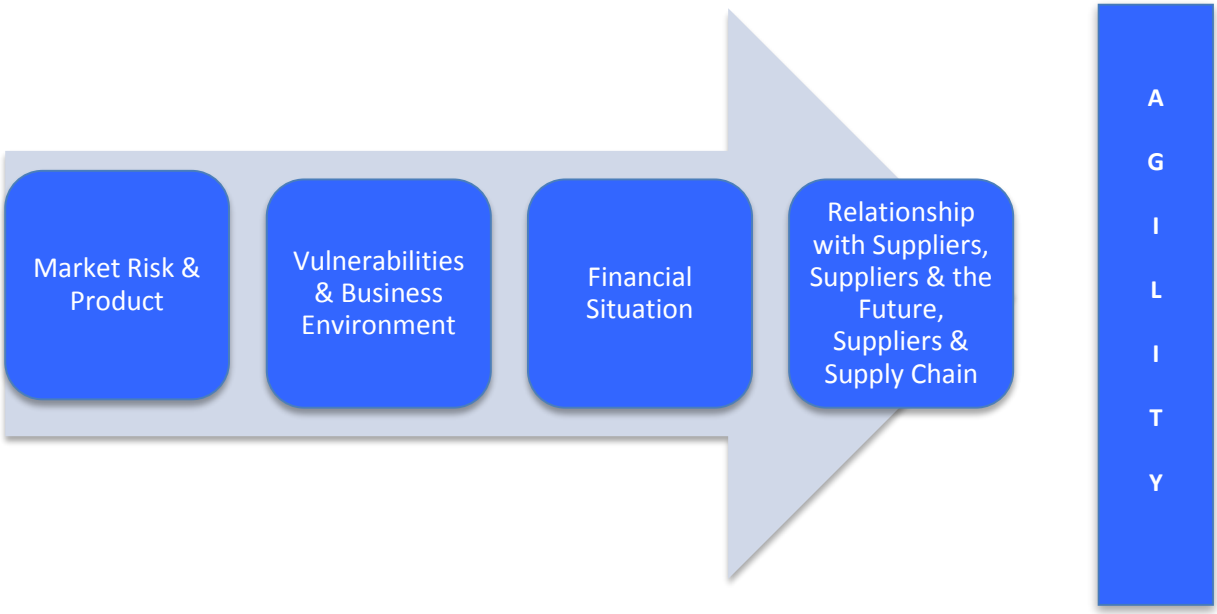


Figure 7. 7 - Path to Organisation G's Agility (Author)

Whilst providing an order of priority for overseeing the roadmap process, this procedure is not linear, subsequently allowing changes to be made. If for example the methodology identifies a roadmap chain order and work subsequently begins on the third roadmap in that chain, an unexpected organisational change impacting work completed on the second roadmap does not invalidate the work accomplished elsewhere – it simply requires work within the scope of the second roadmap to be reviewed.

Having outlined the methodology, each roadmap area will now be presented with a brief explanation of the key points being considered.

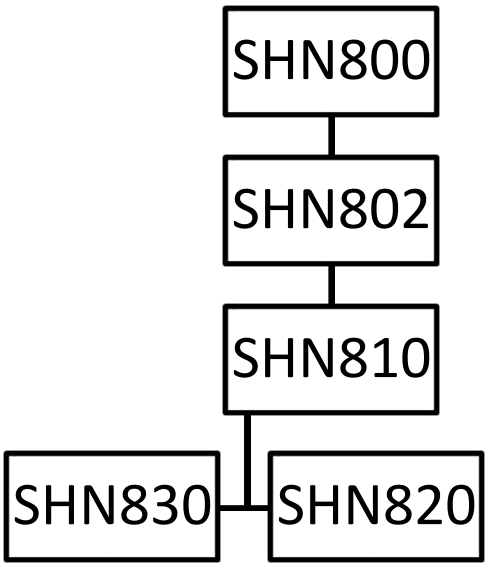
7.3.1 Market Risk and Products Roadmap Chain

Table 7. 5 illustrates the relevant nodes and diagram numbers for the *Market Risk & Products Roadmap*.

Table 7. 5 - Market Risk & Products Roadmap Nodes & Corresponding Diagrams (Author)

Node	Description	Diagram Number
DES/MS0	Determination of Market for Products	SHN800
DES/MS2	Determination of Market Structure & Presence	SHN802
DES/MS10	Determination of Market Place of Operation	SHN810
DES/MS20	Determine Price of Component / Product	SHN820
DES/MS30	Determination of Promotion Format	SHN830

The parent and child relationships of these IDEF0 diagrams are illustrated in Hierarchy Diagram 7. 1.



Hierarchy Diagram 7. 1 - Market Risk & Products Roadmap (Author)

Figure 7. 8 illustrates the top-level activities and the *context diagram* for the Market Risk and Products Roadmap that considers the market demand and product liability from a macro perspective, also taking customer requirements into account. Internally, relevant marketing and operating information needs to be provided to afford a top-level overview for an effective market analysis.

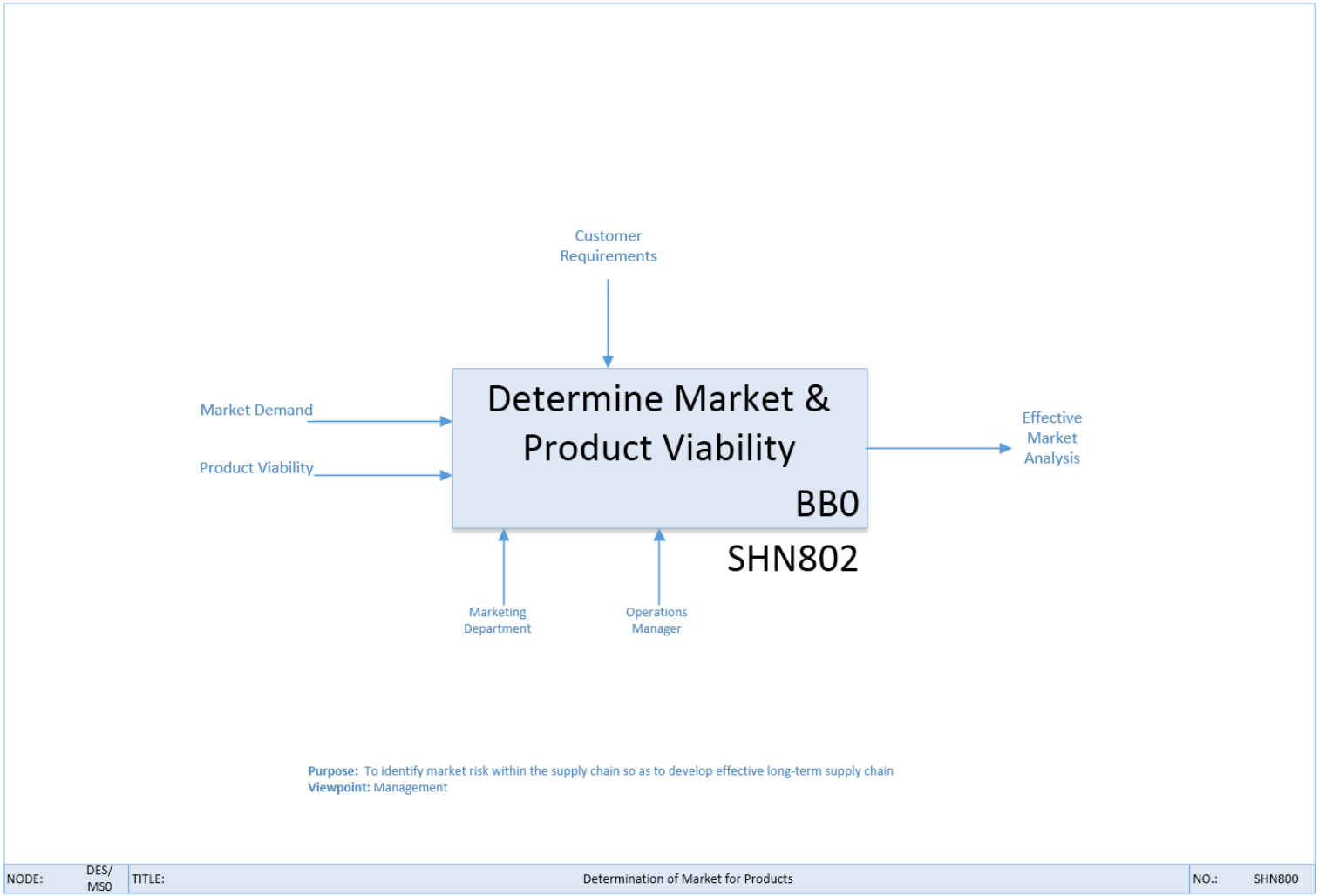


Figure 7. 8 - Determine Market and Product Viability Roadmap (Author)

Figure 7. 9 illustrates the market structure, place within the market, relative importance of product features to the market, attractiveness of the market to the organisation and the supply chain in line with the segmentation, targeting and positioning of products within the said market.

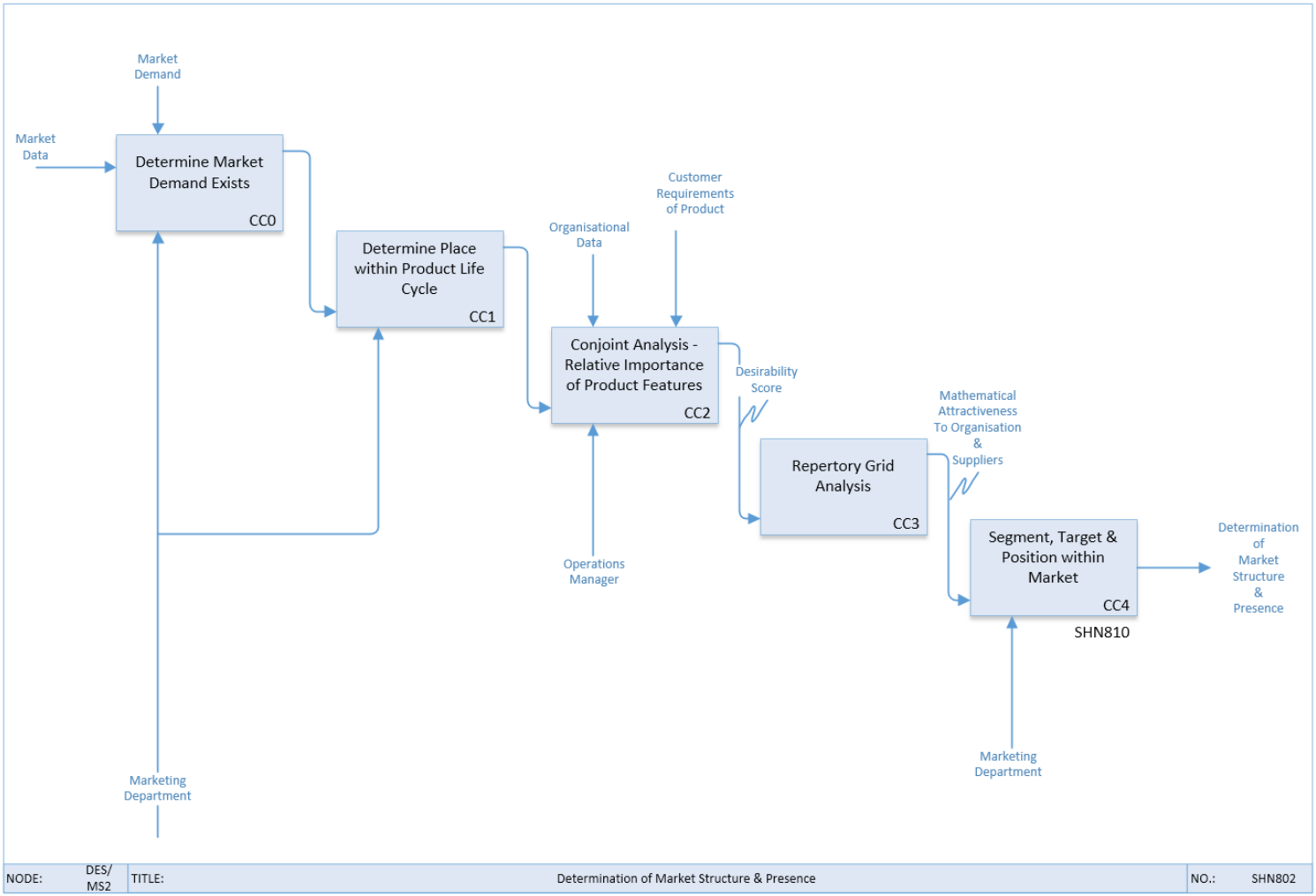


Figure 7. 9 - Determination of Market Structure and Presence Roadmap (Author)

This roadmap incorporates the following stages:

- CC0: Having acquired marketing data and ascertained marketing information, the organisation ascertains whether or not it believes there is a market demand for the products in question.
- CC1: Having determined the existence of a market demand, the company considers the product placement in terms of the product life cycle. New products being introduced to the market will sit within the introductory stage of the life cycle. If the product in question is being introduced to compete within an already existing market, the position within the product life cycle will differ.
- CC2: Utilizing information from the operations manager, organisational data and customer product requirements, the conjoint analysis is run to ascertain the relative importance of product features required by the market.
- CC3: The Repertory Grid Analysis incorporates an element of data from the Conjoint Analysis desirability score and determines a level of attraction of the product for the organisation and suppliers.
- CC4: Employing marketing and Repertory Grid Analysis data, it is now possible to segment, target and position products within the marketplace.

Figure 7. 10 illustrates the Determination of Market Place of Operation Roadmap.

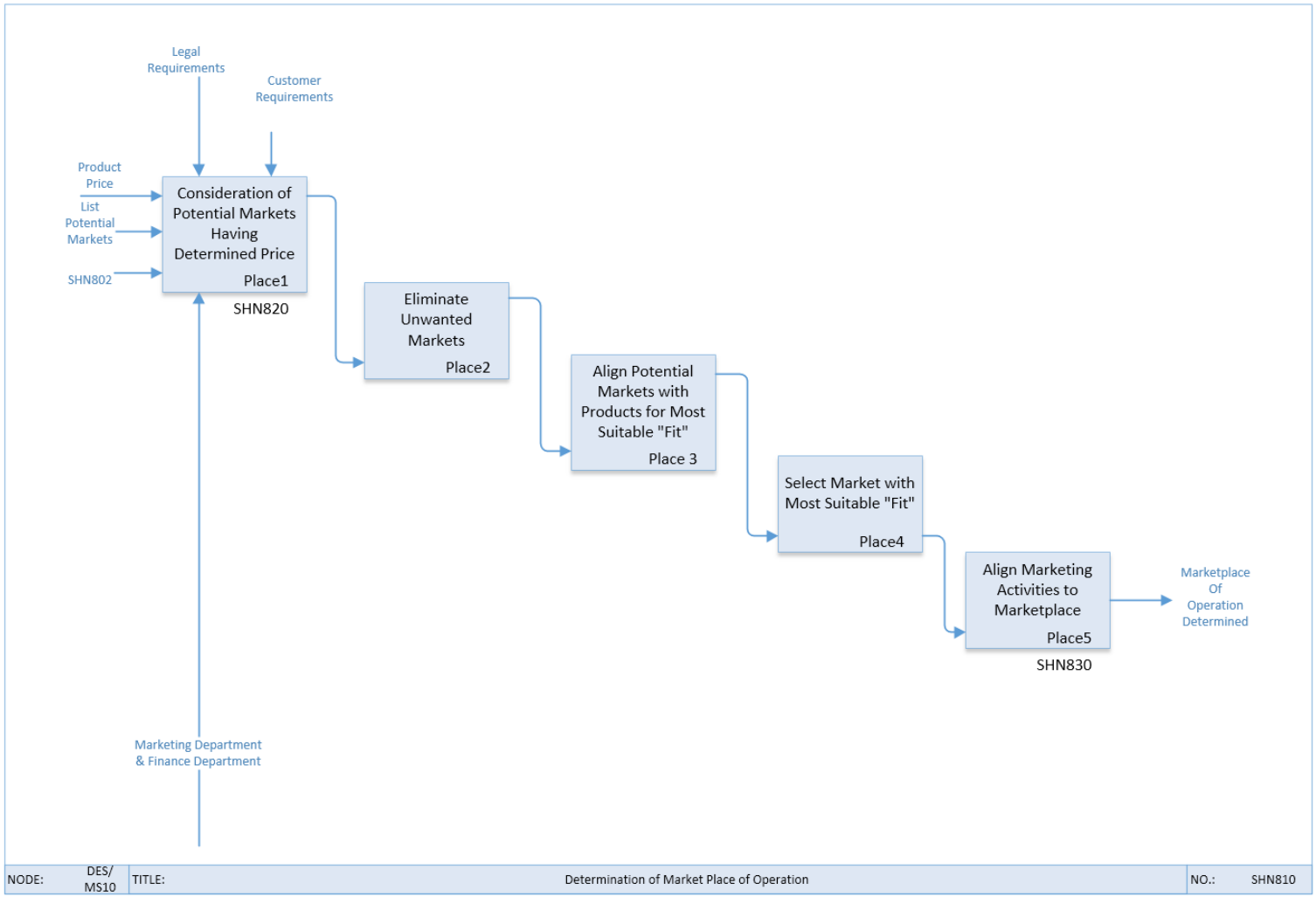


Figure 7. 10 - Determination of Market Place of Operation (Author)

This roadmap incorporates the following stages:

- Place2: Having considered output factors from diagram SHN802, legal and customer requirements, the marketing department and the product price, target markets are determined.
- Place2: Markets of no interest are eliminated from the potential places in which to sell.
- Place3: Align the potential markets with the products in question for the most suitable fit.
- Place4: Select the most appropriate and suitable market for the new product.
- Place5: Marketing activities are aligned to the relevant market for the product. This includes advertising campaigns and promotions.

Figure 7. 11 illustrates the Determination of the Price for a Component or Product Roadmap.

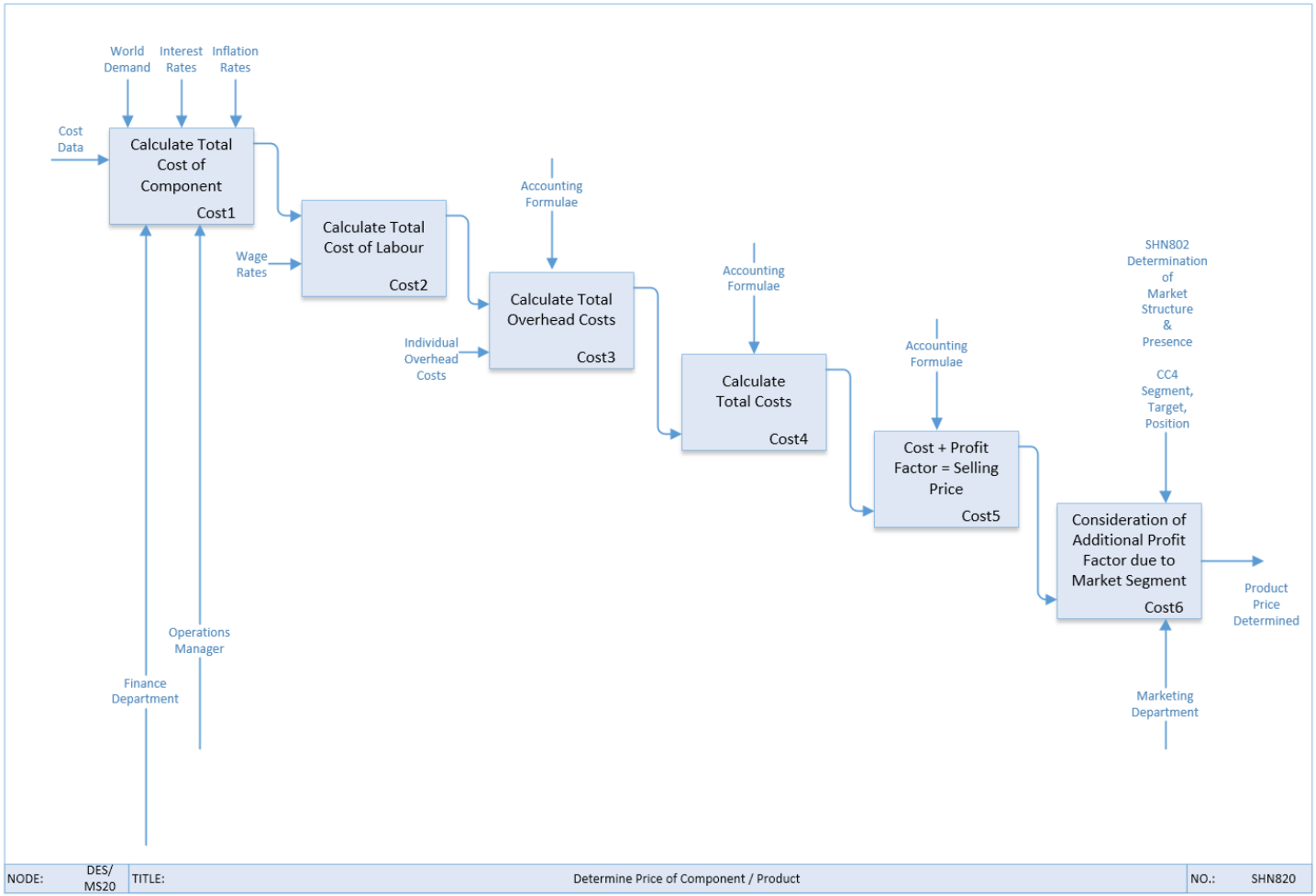


Figure 7. 11 - Determine Price of Component / Product (Author)

This roadmap incorporates the following stages:

- Cost1: Taking into account costing data, world demand, interest rates and inflation rates, the total costs of components are calculated.
- Cost2: Accounting for wage and salary rates (both direct and indirect), the total cost of labour employed in the manufacture of the said components is calculated.
- Cost3: Utilising relevant accounting formulae, the total overhead costs of the manufacturing operation are calculated.
- Cost4: Making use of relevant accounting formulae, the total costs of the manufacturing operation are calculated.
- Cost5: Utilising relevant accounting formulae, the selling price (Costs + Profit Factor required by organisation) are calculated.
- Cost6: Applying data outputs from IDEF0 diagram SHN802 and background information from the marketing department, any additional profit factors due to the market segment the organisation operates within are taken into account (for example, should a product be premium priced, the normal selling price based upon costs and the profit factor would be ignored in favour of the premium price aligned to the product at the point of sale). At this point the product price is determined.

Figure 7. 12 illustrates the Determination of Promotion Format Roadmap.

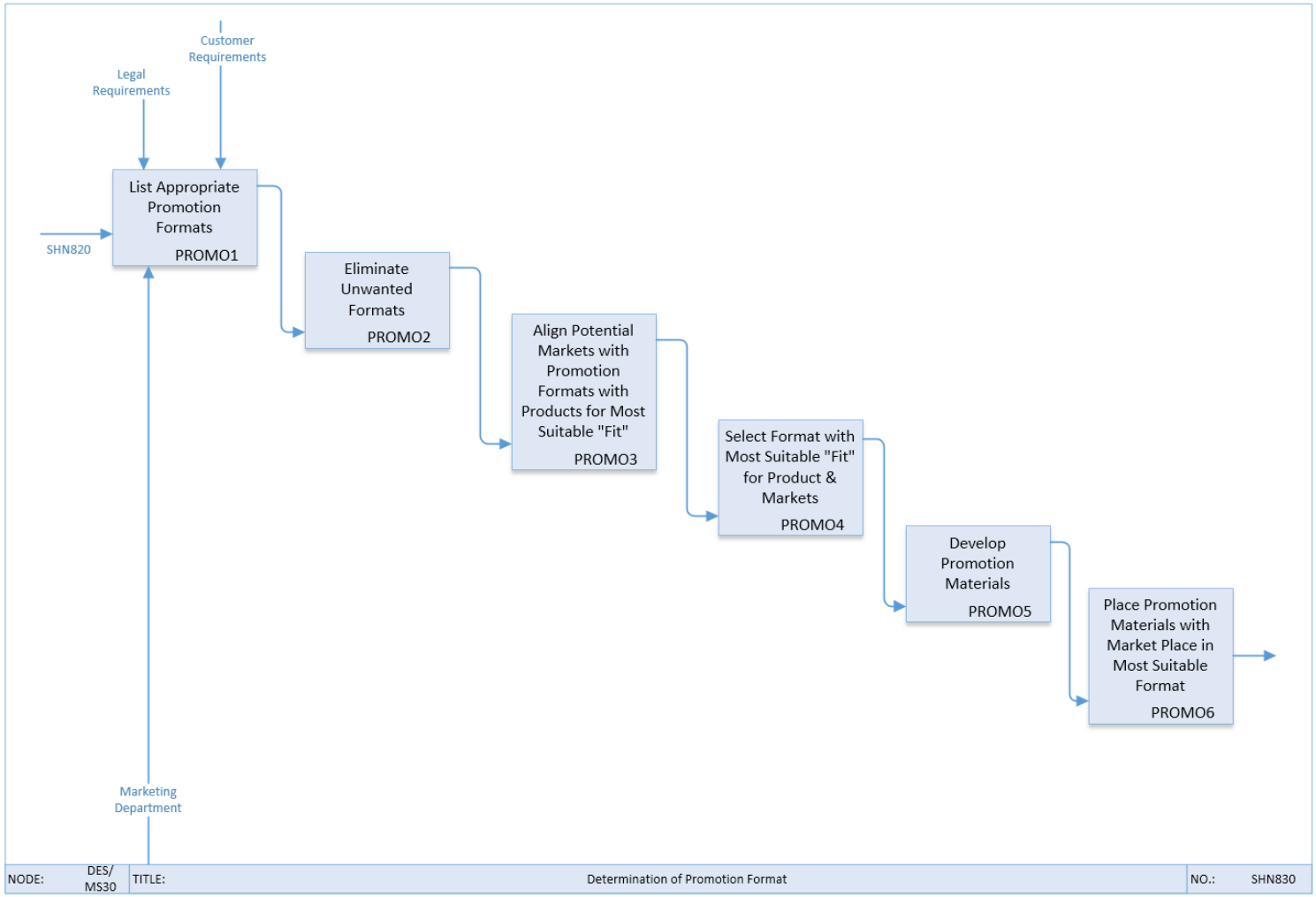


Figure 7. 12 - Determination of Promotion Format (Author)

This roadmap incorporates the following stages:

- Promo1: Utilising data inputs from roadmap SHN820 and taking into account legal issues, customer expectations and requirements, a list of appropriate formats for advertising is devised.
- Promo2: Any unsuitable formats are eliminated from the process.
- Promo3: The most appropriate means of promotion are aligned to the potential product markets.
- Promo4: The most suitable promotion format is selected for the markets the product is aligned to.
- Promo5: Promotional materials are devised and developed pending the product launch.
- Promo6: Promotional materials are utilised to inform the market of the new product.

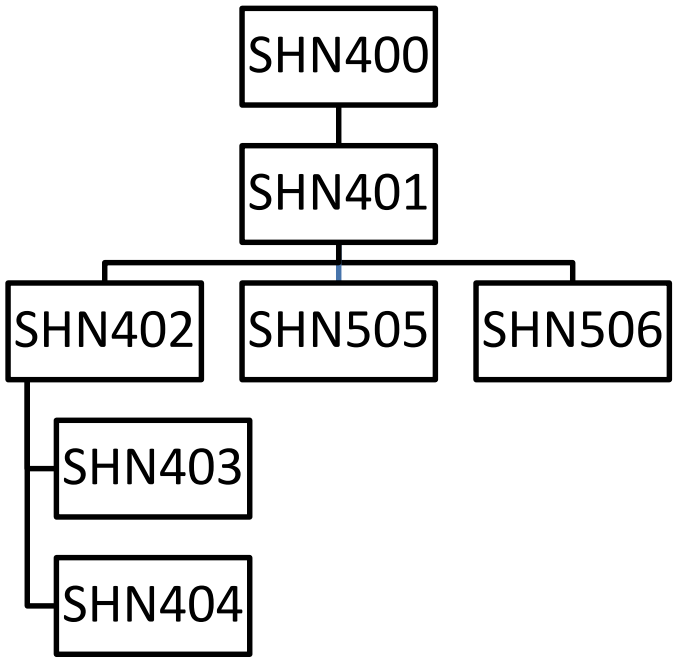
7.3.2 Financial Situation Roadmap Chain

Table 7. 6 illustrates the relevant nodes and diagram numbers for the *Financial Situation Roadmap*.

Table 7. 6 - Economics Roadmap Nodes & Corresponding Diagrams (Author)

Node	Description	Diagram Number
DES/FIN0	Financial Situation Road Map	SHN400
DES/FIN1	Financial Situation Roadmap - Effective Use of Economic Factors	SHN401
DES/FIN2	Financial Situation Road Map - Organisation Financial Status	SHN402
DES/FIN3	Financial Situation Road Map - Financial Operating Costs	SHN403
DES/FIN4	Financial Situation Road Map - Profitability from Sales Relative to Costs	SHN404
DES/FIN5	Financial Situation Road Map - Managing Effects of Inflation	SHN505
DES/FIN6	Financial Situation Road Map - Effect of Interest Rates	SHN506

The parent and child relationships of these IDEF0 diagrams are illustrated in Hierarchy Diagram 7. 2.



Hierarchy Diagram 7. 2 – Financial Status Roadmap (Author)

Figure 7. 13 illustrates the context diagram for the Financial Status Roadmap.

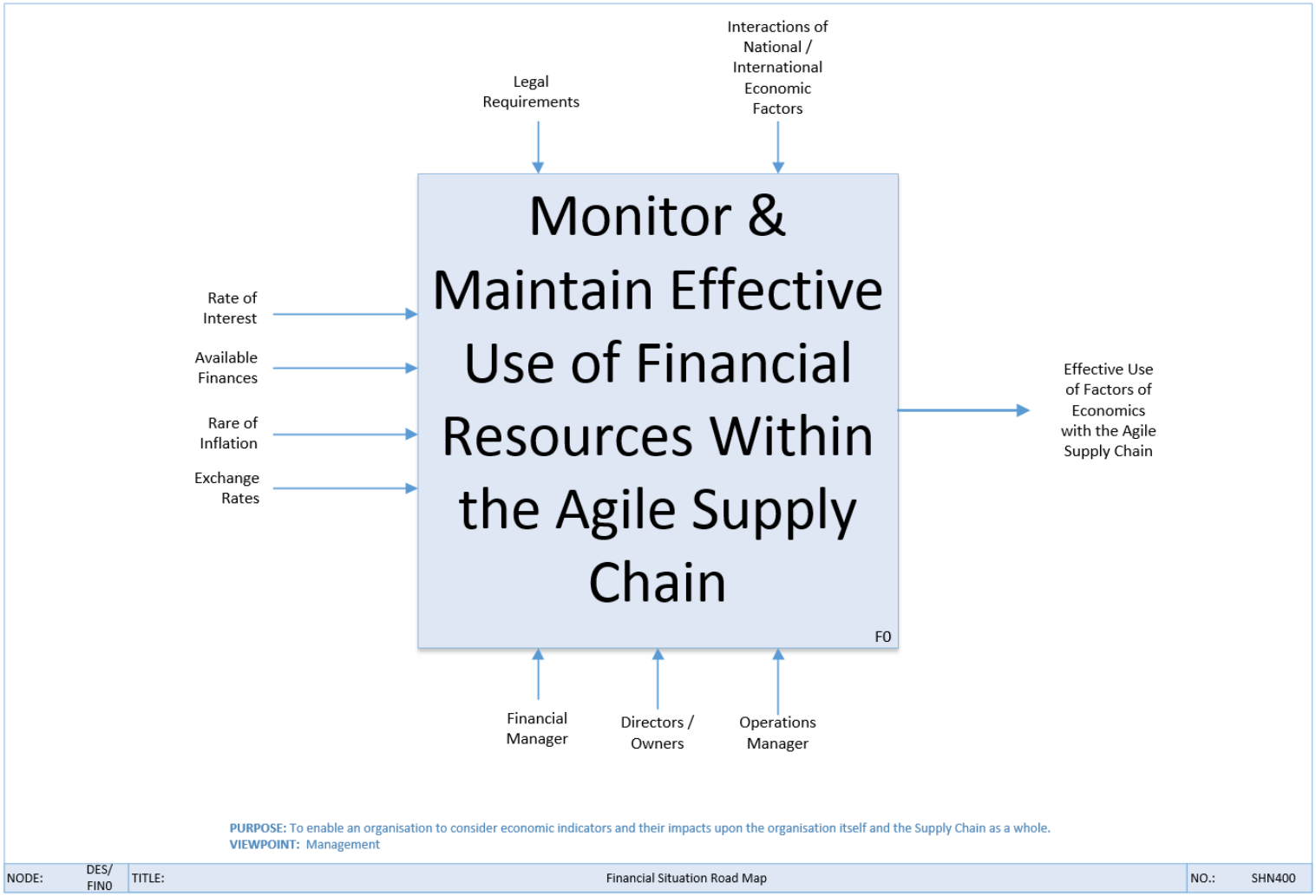


Figure 7. 13 – Financial Status Roadmap (Author)

This roadmap demonstrates the top level of activities for the ways in which organisations need to monitor and maintain their use of financial and economic resources within a supply chain. The inputs are the rates of interest, inflation, exchange and available funding. These factors operate in line with legal requirements and national and international factors of economics. Internally, organisations consider these factors in line with the needs of the Operations Management, owners and financial operations as required. The resultant output is the effective use of these economic factors for the organisation's role within the supply chain.

Figure 7. 14 illustrates the Effective Use of Economic Factors Roadmap.

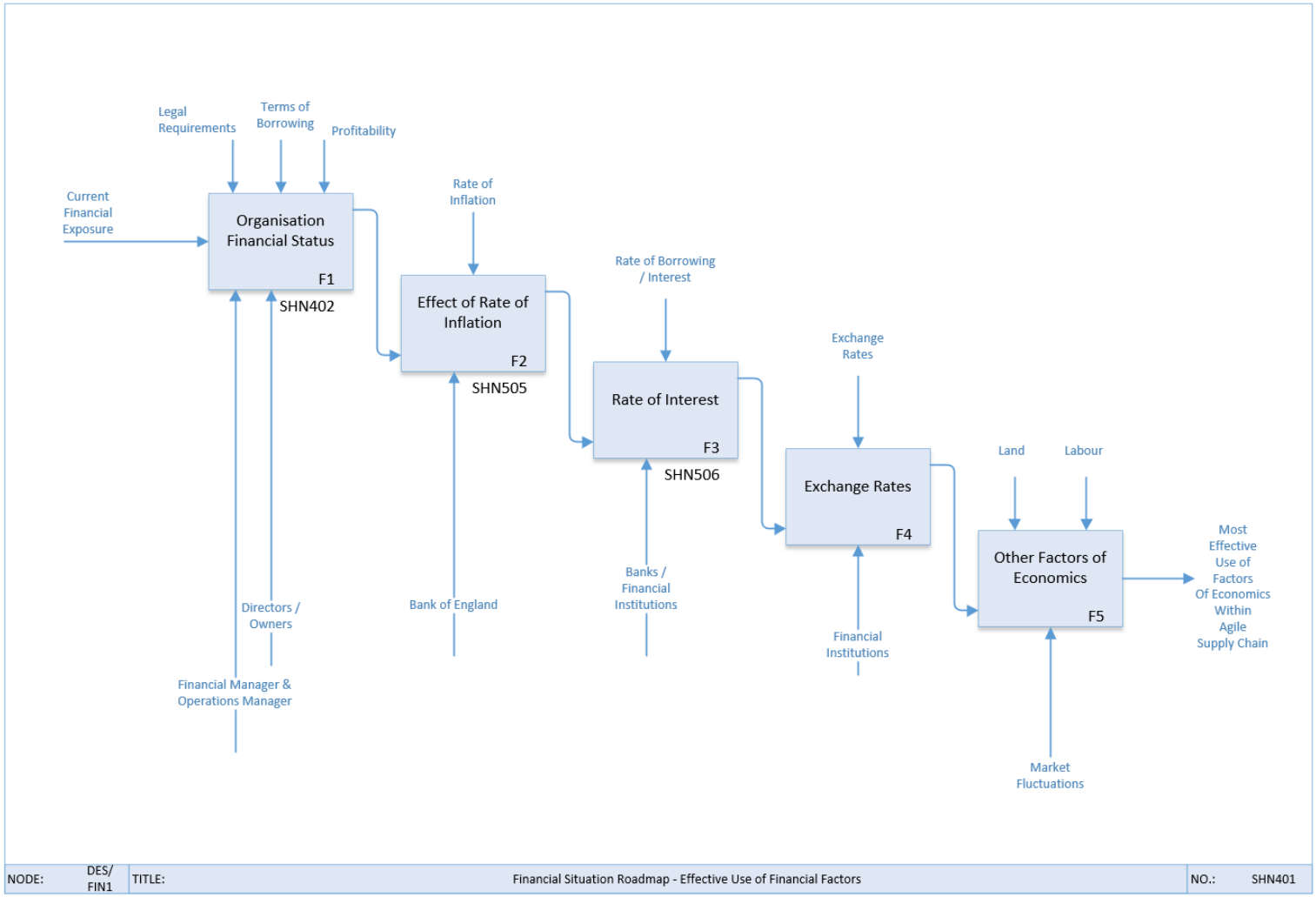


Figure 7. 14 – Financial Situation Roadmap – Effective Use of Economic Factors (Author)

This roadmap incorporates the following stages:

- F1: Giving consideration to the organisation's current financial exposure as an input and taking legal issues, terms of borrowing and profitability, as well as the internal direction provided by management, the organisational financial status is determined.
- F2: Consideration is given to the effect of the rate of inflation on operational matters including but not restricted to factors such as wage costs, overheads and stock holding costs.
- F3: Attention is given to the effect of the rate of interest as determined by the Bank of England base rate and subsequent interest rates levied by financial organisations associated with borrowing made by the organisation.
- F4: Consideration is given to the effect of international exchange rates on the actions of the organisation relative to costs associated with stock purchases and sales abroad.
- F5: Attention is given to other factors of economics such as land and labour as well as micro-economic issues such as supply and demand.

Figure 7. 15 illustrates the consideration given to the Organisational Financial Status.

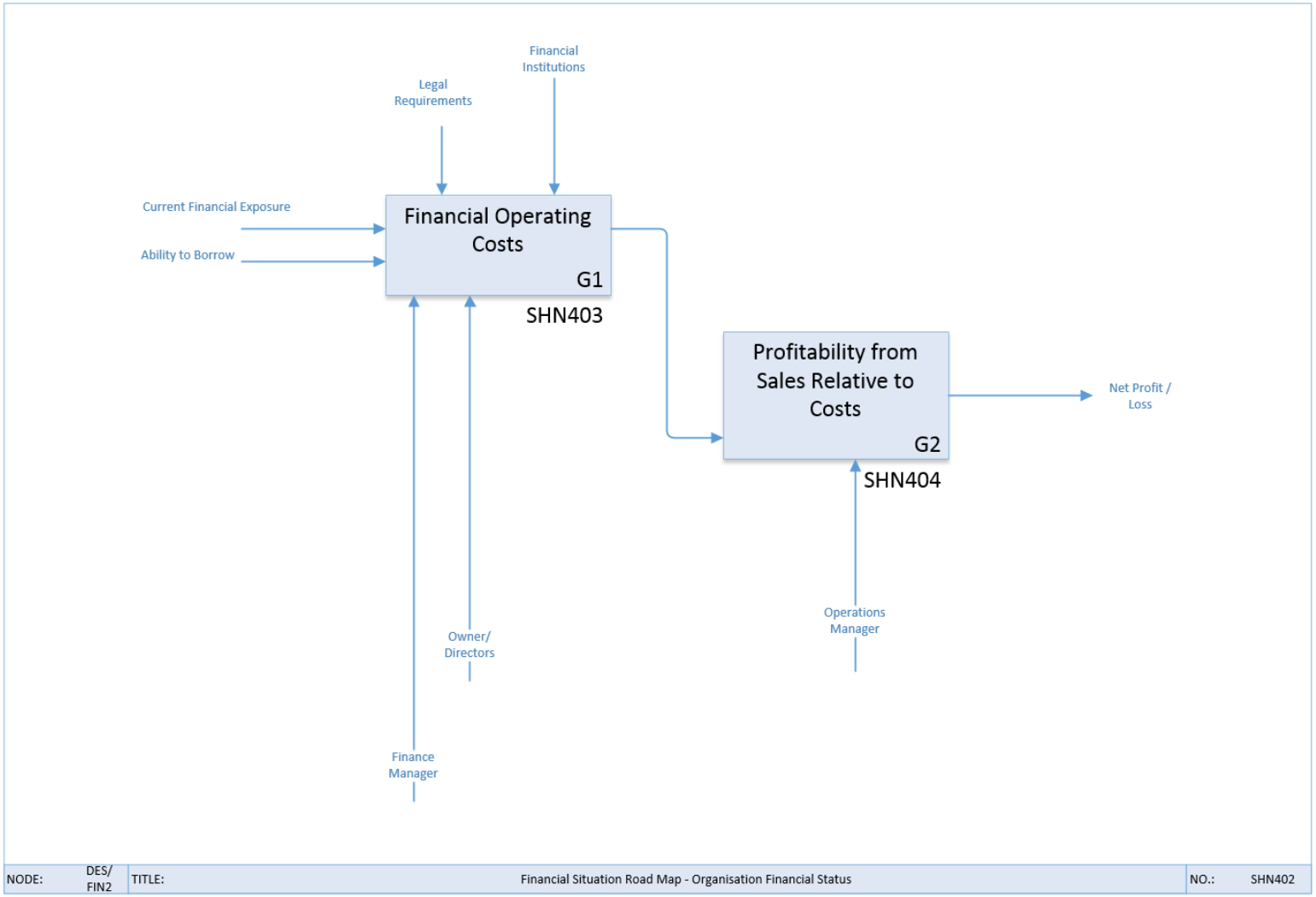


Figure 7. 15 – Financial Situation Roadmap – Organisation Financial Status (Author)

Roadmap diagrams SHN403 and SHN404 feed into this roadmap from one stage lower down the hierarchy. This roadmap incorporates the following stages:

- G1: Taking into account the organisation's current financial exposure and its ability to borrow, along with financial legal requirements and rules evolving from financial institutions in terms of the borrowing, the operating financial costs can be established.
- G2: The overall financial profitability from sales relative to costs can be established and thus a net profit or loss status can be calculated.

Figure 7. 16 illustrates the consideration given to Financial Operating Costs within the roadmap process.

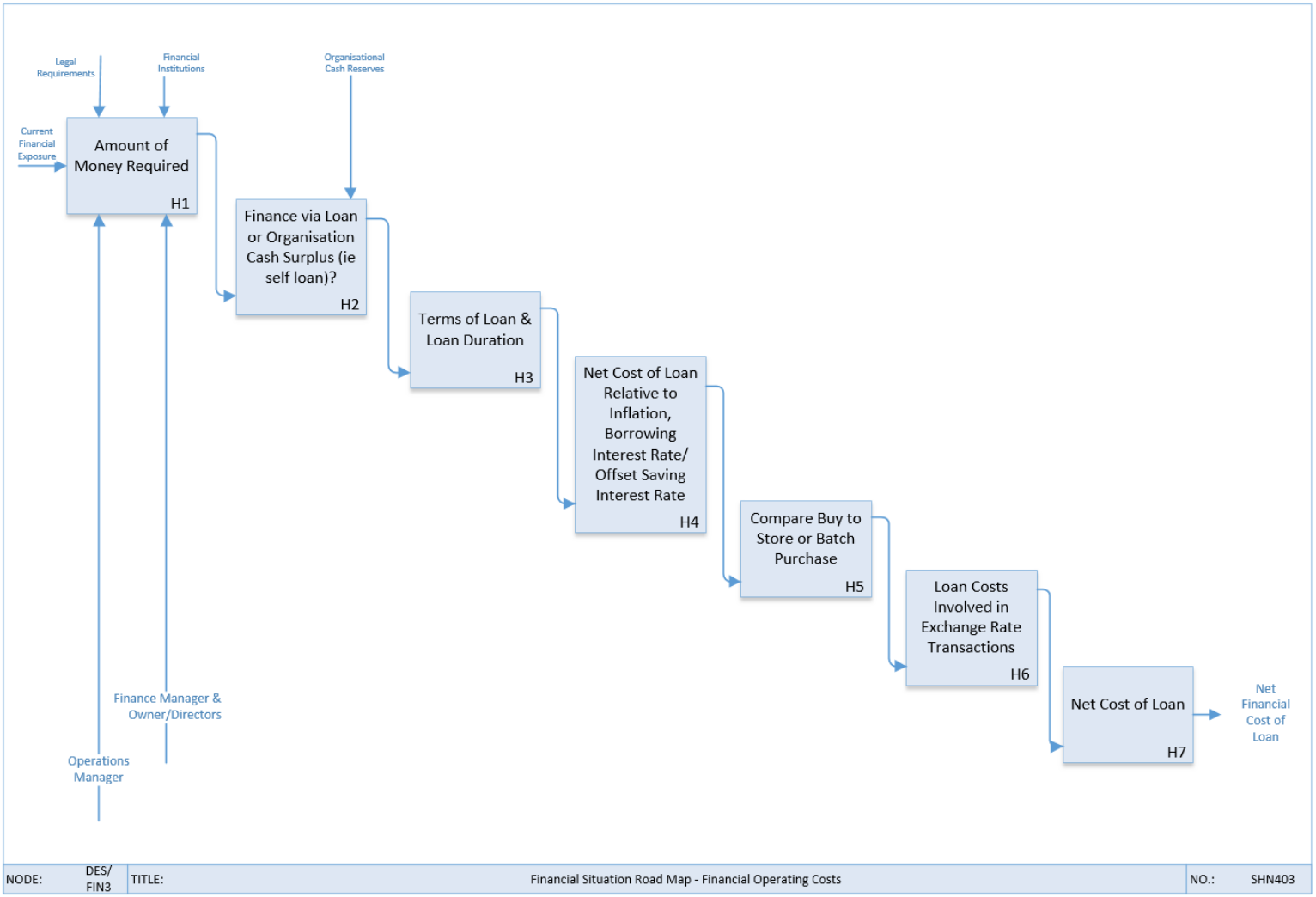


Figure 7. 16 – Financial Situation Roadmap – Financial Operating Costs (Author)

This roadmap incorporates the following stages:

- H1: Taking into account the organisation's current financial exposure, financially based legal restrictions and other impositions made by financial institutions, as well as the needs of the finance and operations managers, the amount of financial assistance the organisation requires in order to meet its operational requirements is established.
- H2: Taking the organisation's cash situation into account, the operation being considered can either be self-financed or externally funded.
- H3: The terms of the loan are established between the organisation and the financial institution it is dealing with.
- H4: The net cost of the loan can be established, taking into account interest and inflation rates. Should the operation be self-financed, similar calculations need to take place to establish the opportunity cost of this option.
- H5: The organisation must consider bulk purchase options with regards storing stock or purchasing more frequently in smaller batches. The costs associated with both should be considered via a Cost Benefit Analysis as both options have impacts, particularly when considered in line with economic factors such as interest, inflation, taxation and exchange rates.
- H6: Loan costs associated with exchange rates (through loans taken out via international lenders) need to be considered in line with economic factors such as interest, inflation and taxation.
- H7: The net cost of the loan can be calculated.

Figure 7. 17 illustrates the Profitability from Sales Relative to Costs.

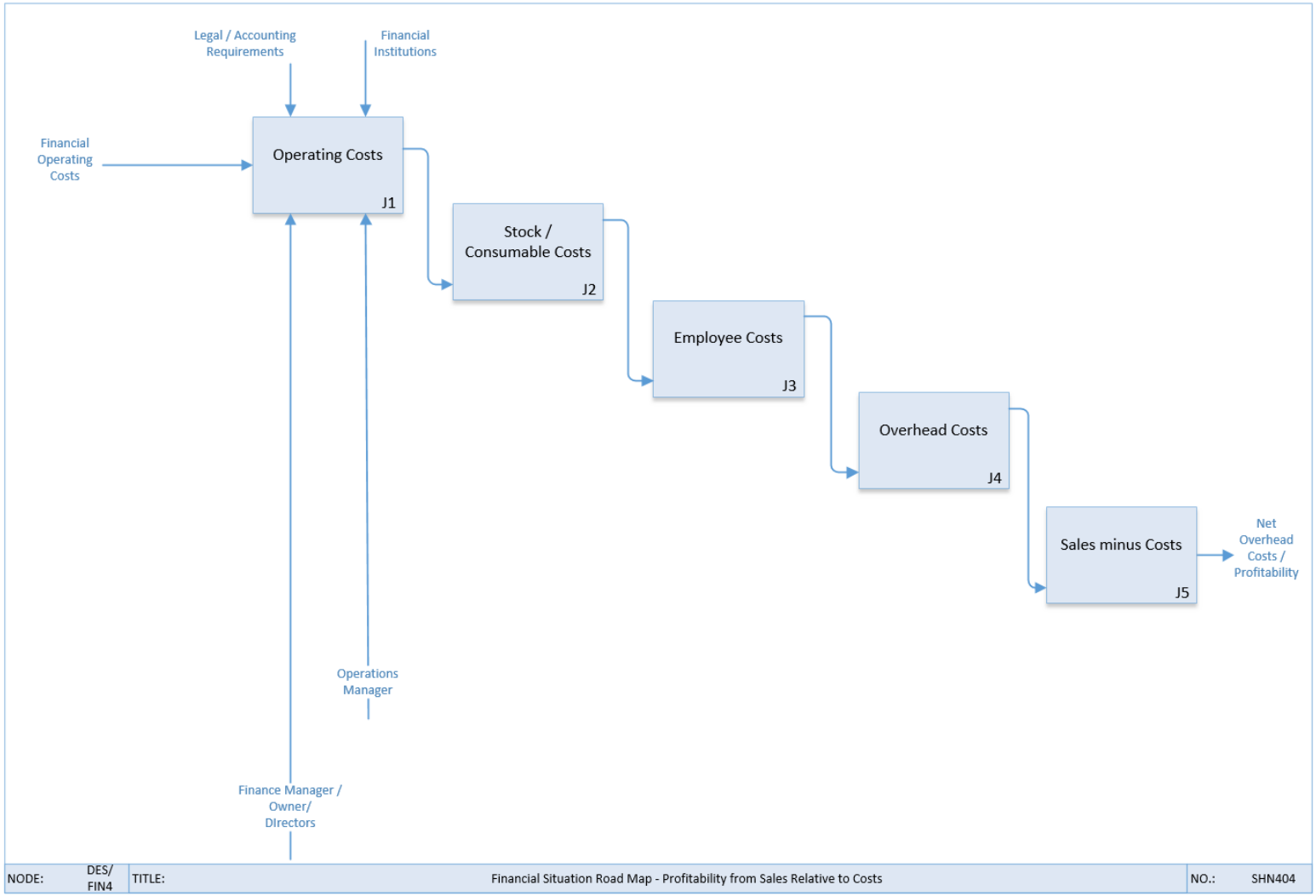


Figure 7. 17 – Financial Situation Road Map – Profitability from Sales Relative to Costs (Author)

This roadmap incorporates the following stages:

- J1: Taking the financial operating costs as inputs as well as legal restrictions and other impositions made by financial institutions, as well as the needs of the finance and operations managers, general operating manufacturing costs can be established.
- J2: Purchasing, stock holding and consumable costs can be calculated.
- J3: Staff employment costs can be calculated.
- J4: Overhead costs can be calculated.
- J5: Having established the total manufacturing costs for the said product, the organisation can ascertain the net overhead costs and profitability by subtracting the sales revenue from the overall costs.

Figure 7. 18 illustrates the roadmap relating to Managing the Effects of Inflation.

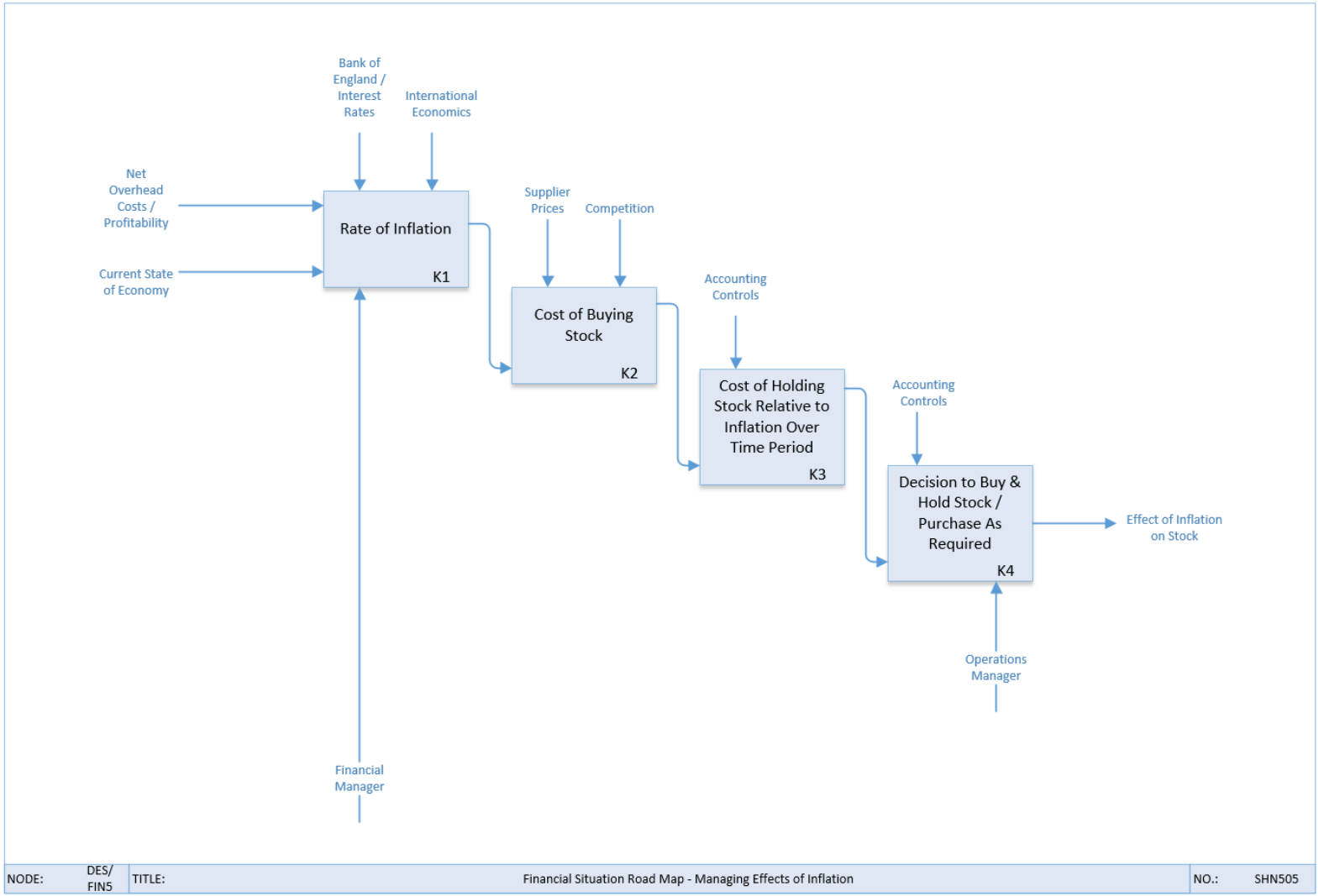


Figure 7. 18 – Financial Situation Road Map – Managing the Effects of Inflation (Author)

This roadmap incorporates the following stages:

- K1: Taking into account the present state of the economy in line with the Bank of England and factors of international economics, as well as overhead costs and profitability, the rate of inflation can be established not only for the general rate of inflation (RPI) but also the rates of inflation for individual components making up the product in question.
- K2: Taking into account the rate of inflation, supplier prices and the level of competition for components within the market place, the true cost of purchasing stock can be established.
- K3: Through the use of effective accounting controls the organisation can establish the true cost of holding stock over any given period relative to inflation and the cost of borrowing for the stock in question.
- K4: In line with accounting controls, the decision as to whether or not to purchase stock and store it until required or purchase the stock as and when needed can be taken.

Figure 7. 19 illustrates the Effect of Interest Rates Roadmap.

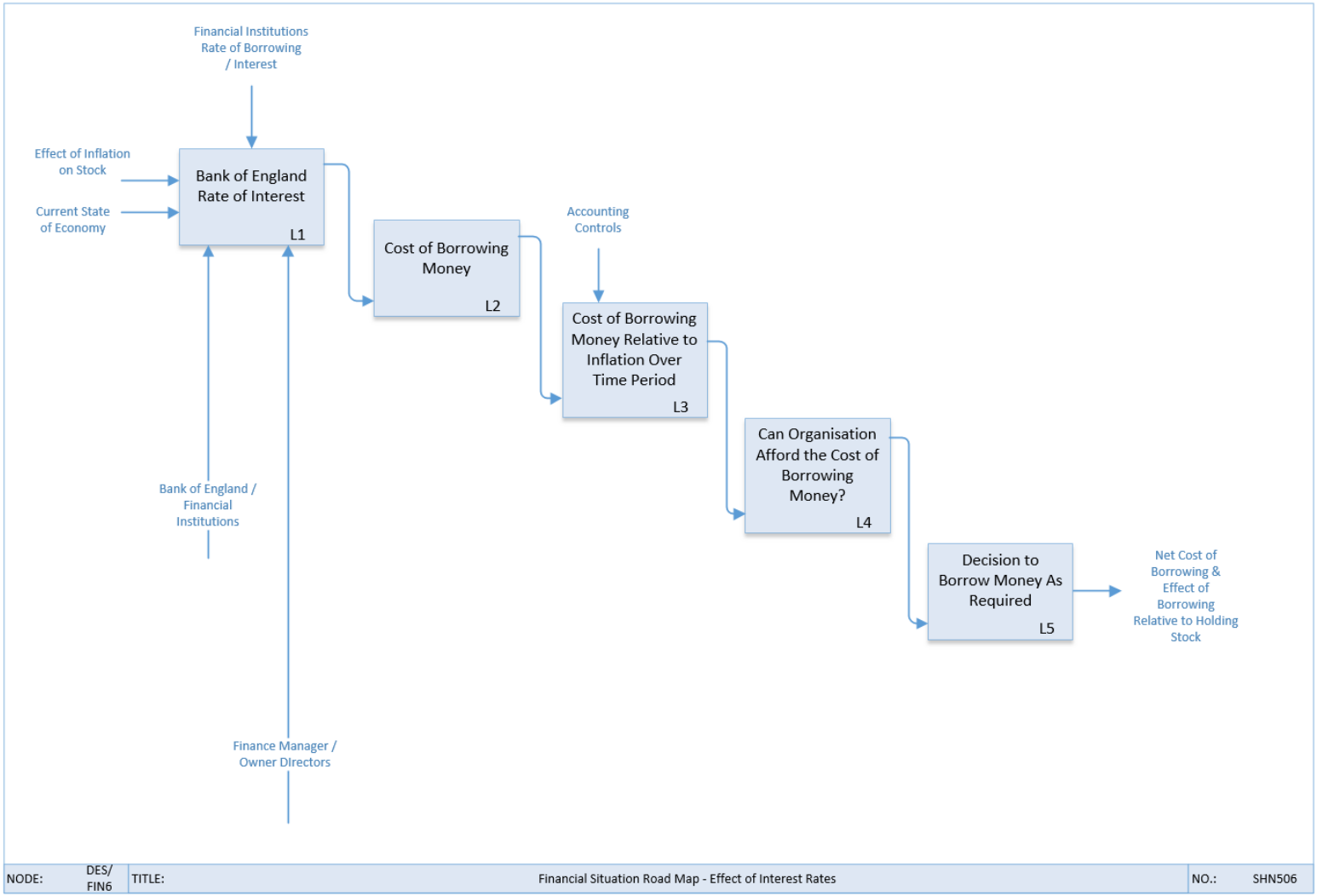


Figure 7. 19 – Financial Situation Road Map – Effect of Interest Rates (Author)

This roadmap incorporates the following stages:

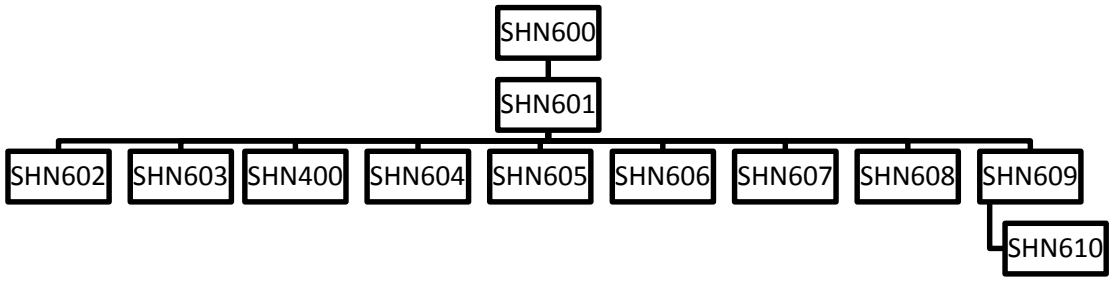
- L1: Taking into account the present state of the economy, the short and long-term effects of inflation on stock and the Bank of England and other financial institution regulations, the Bank of England base rate can be established and put into perspective, providing an insight into the stability of the financial, economic and market situations the organisation is operating within.
- L2: The true cost of borrowing money can be established.
- L3: Making use of accounting regulations, the true cost of borrowing relative to the rate of inflation can be established over a given time period. This is important as higher rates of inflation make it cheaper to borrow as the inflation effectively eradicates part of the debt over time.
- L4: Having established the true costs of borrowing, the organisation can establish whether or not it can afford to take out loans and how large such loans can realistically be.
- L5: The decision to borrow money can be made.

7.3.3 Vulnerabilities Roadmap Chain

Table 7. 7 illustrates the relevant nodes and diagram numbers for the *Vulnerabilities Roadmap*. The parent and child relationships of these IDEF0 diagrams are illustrated in Hierarchy Diagram 7. 3.

Table 7. 7 - Vulnerabilities Roadmap Nodes & Corresponding Diagrams (Author)

Node	Description	Diagram Number
DES/VULN0	Avoiding Vulnerabilities Road Map	SHN600
DES/VULN1	Identify Potential Areas of Vulnerability	SHN601
DES/VULN2	Highlighting Societal Vulnerabilities	SHN602
DES/VULN3	Highlighting Infrastructural / Transportational Vulnerabilities	SHN603
DES/VULN4	Highlighting HR Vulnerabilities	SHN604
DES/VULN5	Highlighting Legal Vulnerabilities	SHN605
DES/VULN6	Highlighting Energy Vulnerabilities	SHN606
DES/VULN7	Highlighting Technological Vulnerabilities	SHN607
DES/VULN8	Highlighting Financial Vulnerabilities	SHN608
DES/VULN9	Highlighting Environmental Vulnerabilities	SHN609
DES/VULN10	Potential Environmental Vulnerabilities	SHN610



Hierarchy Diagram 7. 3 - Vulnerabilities Roadmap (Author)

Figure 7. 20 illustrates the *context diagram* for the Avoiding Vulnerabilities Roadmap.

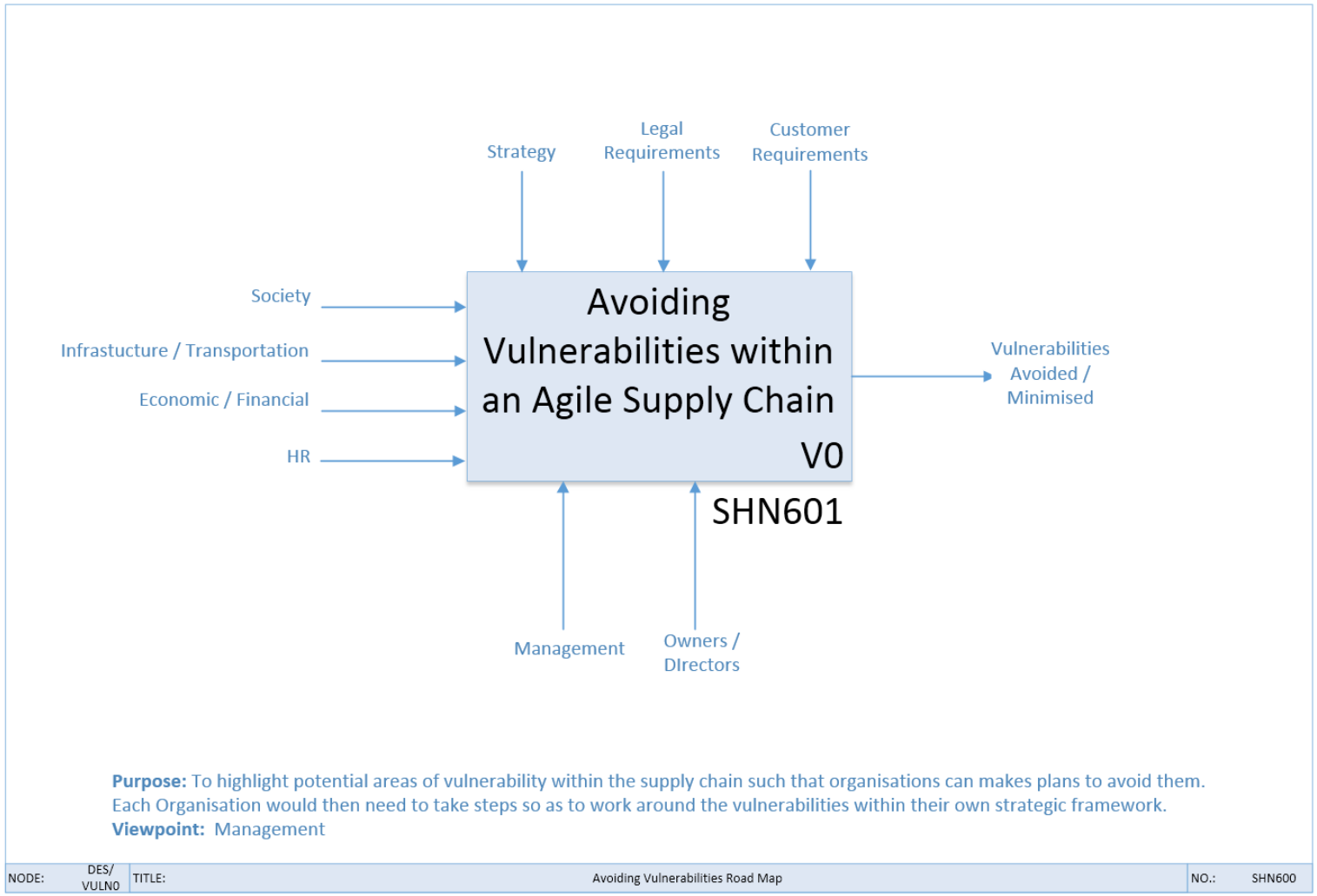


Figure 7. 20 - Avoiding Vulnerabilities Roadmap (Author)

To avoid vulnerabilities within the agile supply chain, an organisation needs to take into context its needs in terms of infrastructure, transportation, economic and financial issues, human resource issues, society as a whole, management and owners requirements, the general business strategy, as well as legal and customer requirements (as considered within the Literature Review and further to data gathered from the case studies). Through this and being aware of the potential vulnerabilities that could exist within them, the chances of vulnerabilities leading to costly experiences are reduced.

Figure 7. 21 illustrates the Identification of Potential Areas of Vulnerability Roadmap.

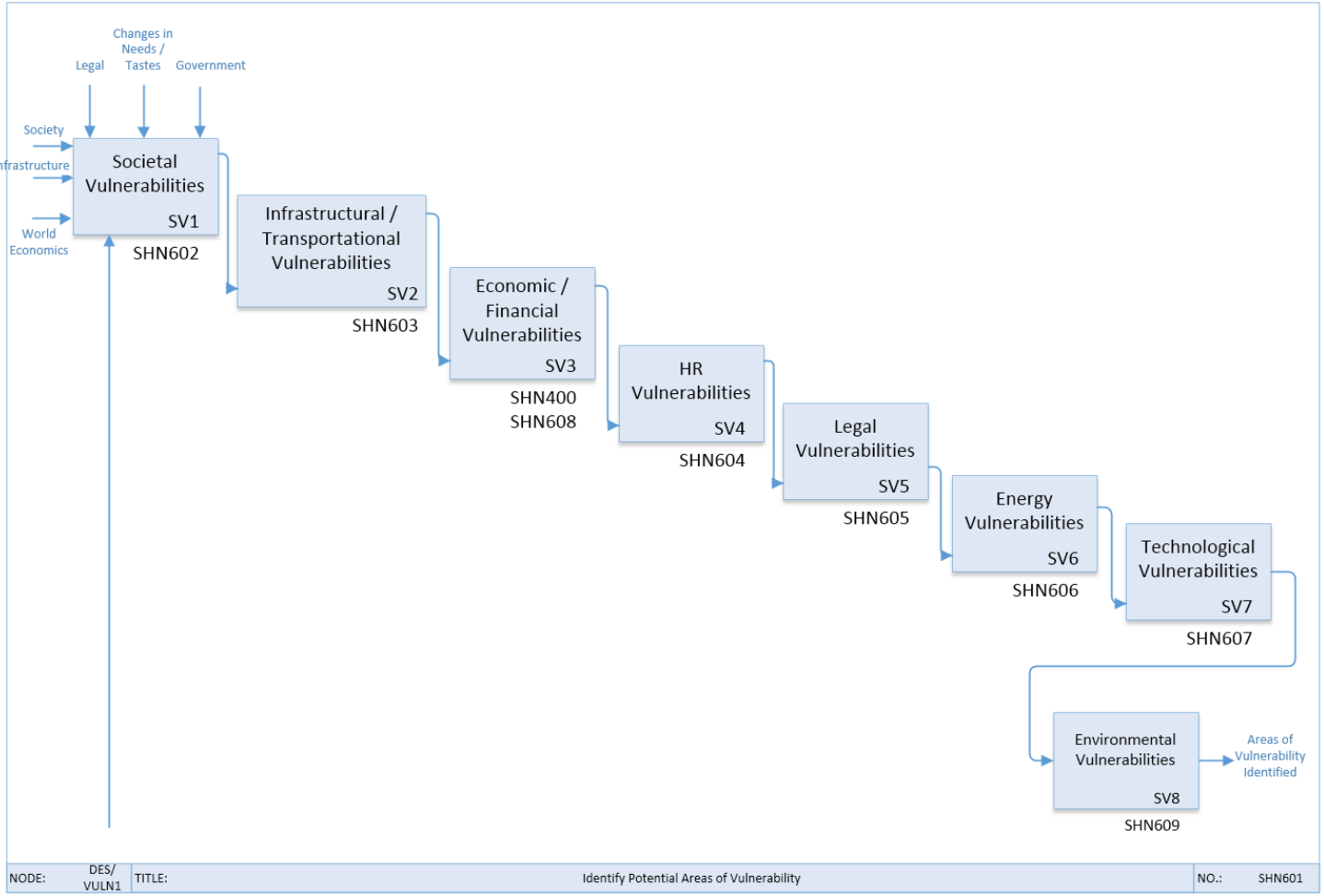


Figure 7. 21 - Identify Potential Areas of Vulnerability Roadmap (Author)

This roadmap incorporates the following stages:

- SV1: To avoid potential difficulties, an organisation needs to be aware of the potential conflicts that might arise within its operations. By considering issues including world economics, business infrastructures, society at large, societal infrastructure, legal requirements, taste changes, customer needs, and issues that the government may raise, societal vulnerabilities as a whole need to be considered.
- SV2: Organisations need to be aware of potential infrastructural and transportation vulnerabilities. These may take the form of infrastructural requirements including gas, electricity and communication technologies. Transport provides an additional perspective to consider, as the organisation needs to be aware of issues relating to interconnections with roads, motorways, airports, and seaports. Transportation facilities need to be considered in terms of the supply chain, ease-of-use of transportation methods and the qualifications required for those employed to operate them. Due to legal issues, consideration now has to be given to the type of transportation being utilised and the emissions emerging therein.
- SV3: Organisations should be aware of economic issues and vulnerabilities. Whilst these have been considered within other roadmaps, it is important to consider the vulnerability of the organisation relative to the way customers and supply chain members will respond and react to changes within the economic system as a whole. Whilst an organisation might not be carrying any financial debts and consequently not be incurring interest charges, a rise in interest rates would impact society at large, subsequently slowing down economic activity that could ultimately impact sales. The consequences resulting from such macro-economic changes would result in financial implications for the organisation. Other macro-economic issues such as taxation and exchange rate fluctuations might impact similarly on the organisation.
- SV4: Due to changing employment legislation and societal expectations regarding issues such as employment rights and pension requirements, organisations are potentially vulnerable to human resource issues. Furthermore, organisations needing to employ individuals with specialist skills to develop new products might find it challenging to recruit and keep employees within certain positions. It is therefore important for such organisations to invest in strong human resource management practices to avoid encountering such vulnerabilities that could have negative financial implications.
- SV5: Societal, legal changes and expectations are resulting in organisations facing ever-increasing vulnerability from a legal perspective. Such issues include human resource related concerns, those relating to financial losses from employees, customers and anyone else in the supply chain. It is also possible for organisations to encounter legal issues from

societal stakeholders that might otherwise not be considered to be directly related to the organisation.

- SV6: Whilst energy shortages have not been an issue over the last 30 years in the UK, organisations are still vulnerable to energy-related matters with regards energy price inflation. Energy price rises have profit implications for any organisation and therefore from the perspective of gas, electricity and vehicle fuel, organisations need to be aware of potential challenges. Furthermore, when considering the global economic climate and international political situations, it is wise for organisations to be aware of the general politico-economic situation if they sell products in other countries, as energy supplies are not necessarily stable throughout the world. Should such issues arise there might well be financial implications for the organisation.
- SV7: Organisations should be generally aware of any vulnerabilities that can come about through technology. Organisations should equally be aware of any vulnerabilities they might encounter due to their lack of use of manufacturing or communication technologies.
- SV8: Organisations need to be aware of general environmental issues affecting their organisation. These can be at the manufacturing base and within their wider sales regions. Should such issues come to pass, the organisation should be aware of the vulnerabilities it faces and ought to prepare an appropriate means of response to avoid the financial losses that might occur.

Figure 7. 22 illustrates the Highlighting Societal Vulnerabilities Roadmap.

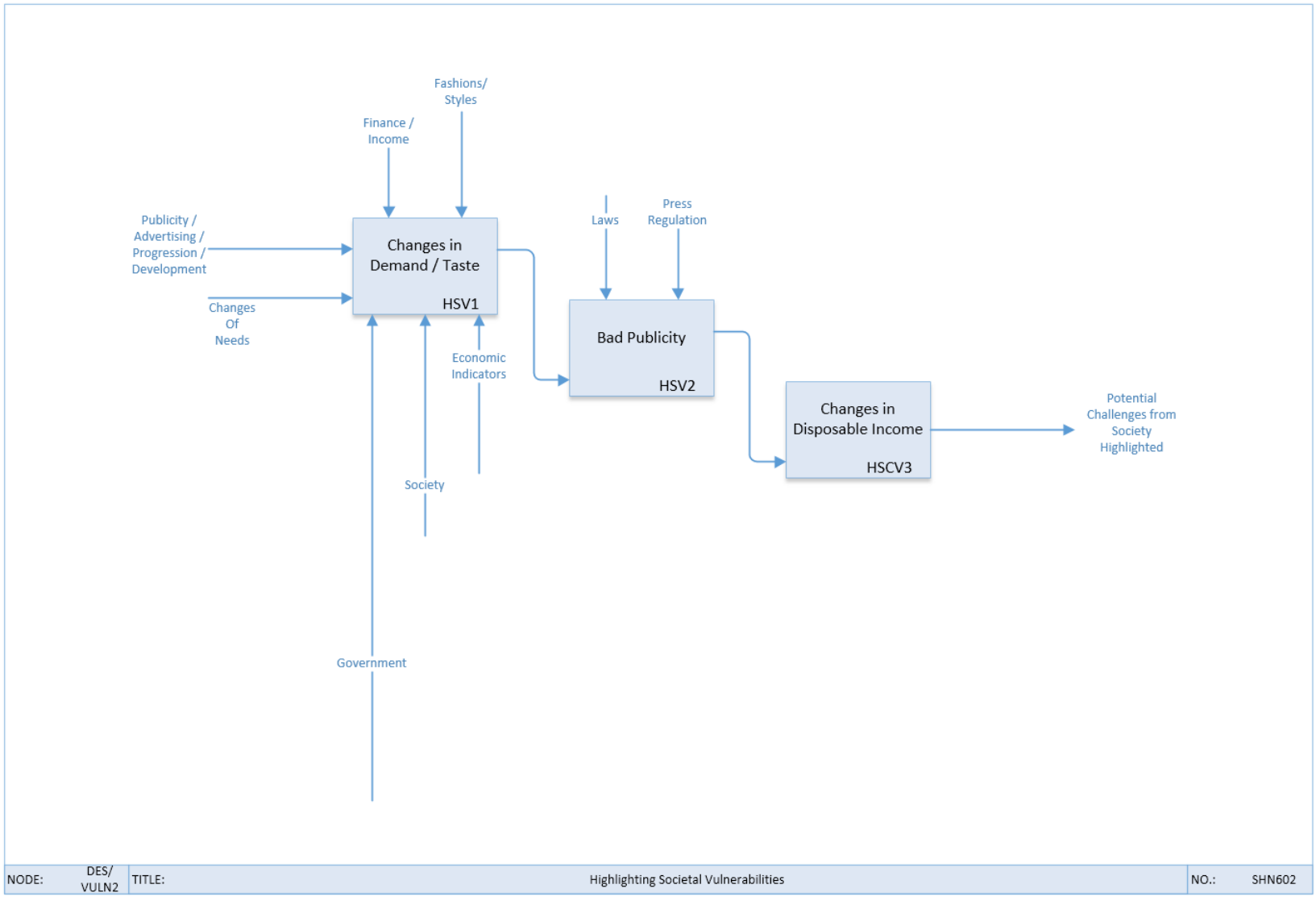


Figure 7. 22 - Highlighting Societal Vulnerabilities Roadmap (Author)

This roadmap incorporates the following stages:

- HSV1: Due to changes of need, advertising, general developments within society as well as government related issues, economic issues, consumer income and tastes, organisations should be aware of the potential challenges they could face due to a fall in demand for the products sold.
- HSV2: Organisations should be aware of the potential vulnerabilities coming from bad publicity in line with legal operating issues and press regulation.
- HSV3: Organisations should be aware of the implications faced relating to changes in customer disposable income. Positive changes to disposable income could result in an increase in sales, which in turn would require an increase in product availability to meet the new demand. A decrease in disposable income would result in fewer sales that could arguably result in the need to employ less people (possibly costing redundancy payments) and reduce output. Financial implications would result in both the scenarios.

Figure 7. 23 illustrates the Highlighting of Infrastructural and Transportational Vulnerabilities Roadmap.

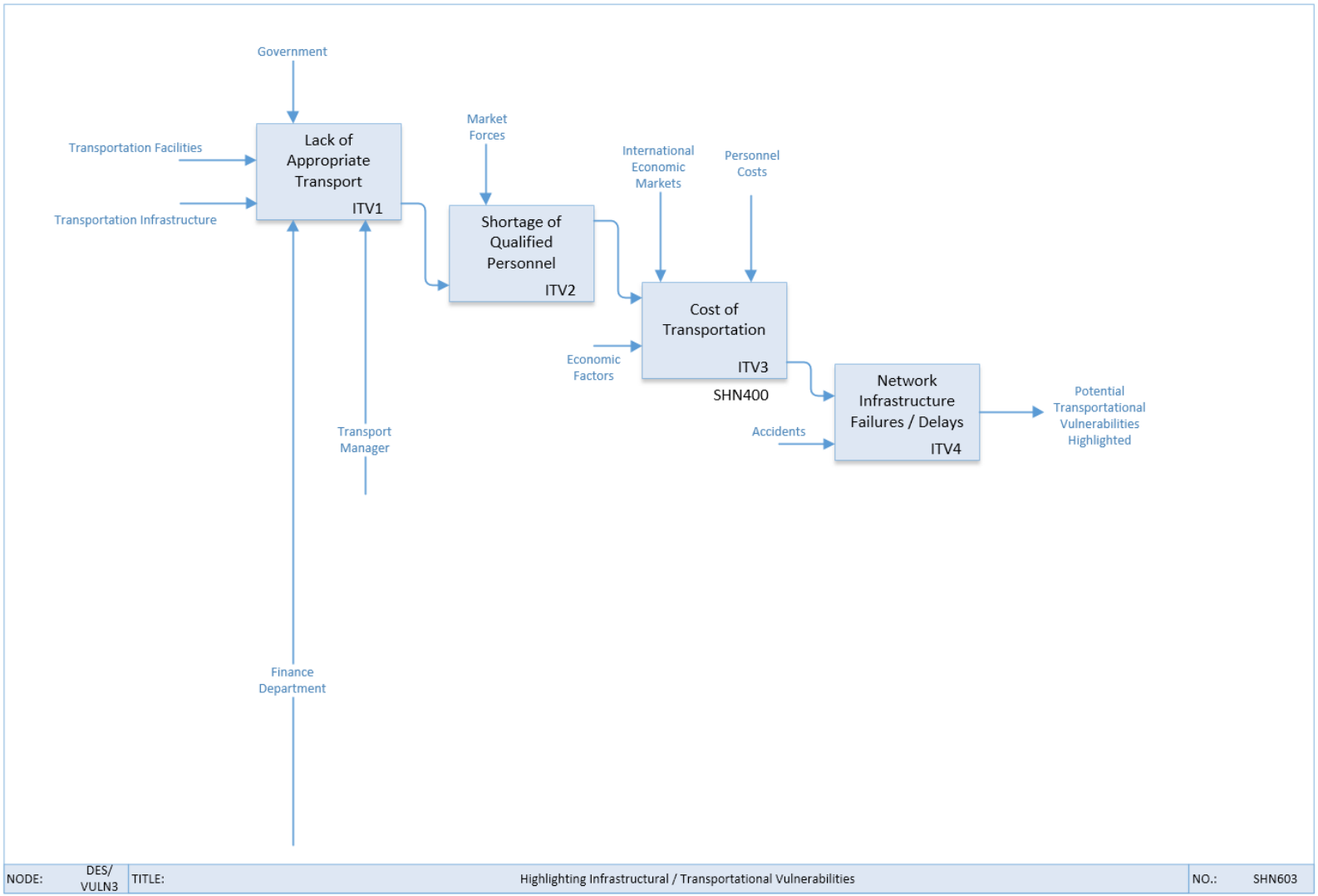


Figure 7. 23 - Highlighting Infrastructural and Transportational Vulnerabilities (Author)

This roadmap incorporates the following stages:

- ITV1: Taking into account the transportational infrastructure organisations must operate within and the transportation facilities utilised along with governmental transport influences, organisations must face the potential vulnerability relating to a lack of appropriate transport. This may come about through insufficient volume of transport or due to unforeseen breakdowns – both of which result in products failing to reach customers at the desired times. This has financial implications so appropriate management of the situation is required.
- ITV2: Due to market forces, it may transpire there to be a lack of qualified personnel to maintain the required infrastructure and transportation levels. This requires careful HR management to minimise such an occurrence and provision should be in place to diminish the effects should they arise.
- ITV3: Due to internationally driven oil prices and other economic factors (such as currency values being related to the cost of oil), transport costs can fluctuate. Provision should be made to smooth such costs over periods as long as possible. This may come through the use of advanced technologies in terms of engine management, the maximisation of delivery loads or in changing the transportation format used.
- ITV4: Road, rail and water networks invariably temporarily fail and result in delivery delays. Organisations should therefore make provision for alternative means of transport to minimise financial losses in this arena.

Figure 7. 24 illustrates the Highlighting of HR Vulnerabilities Roadmap.

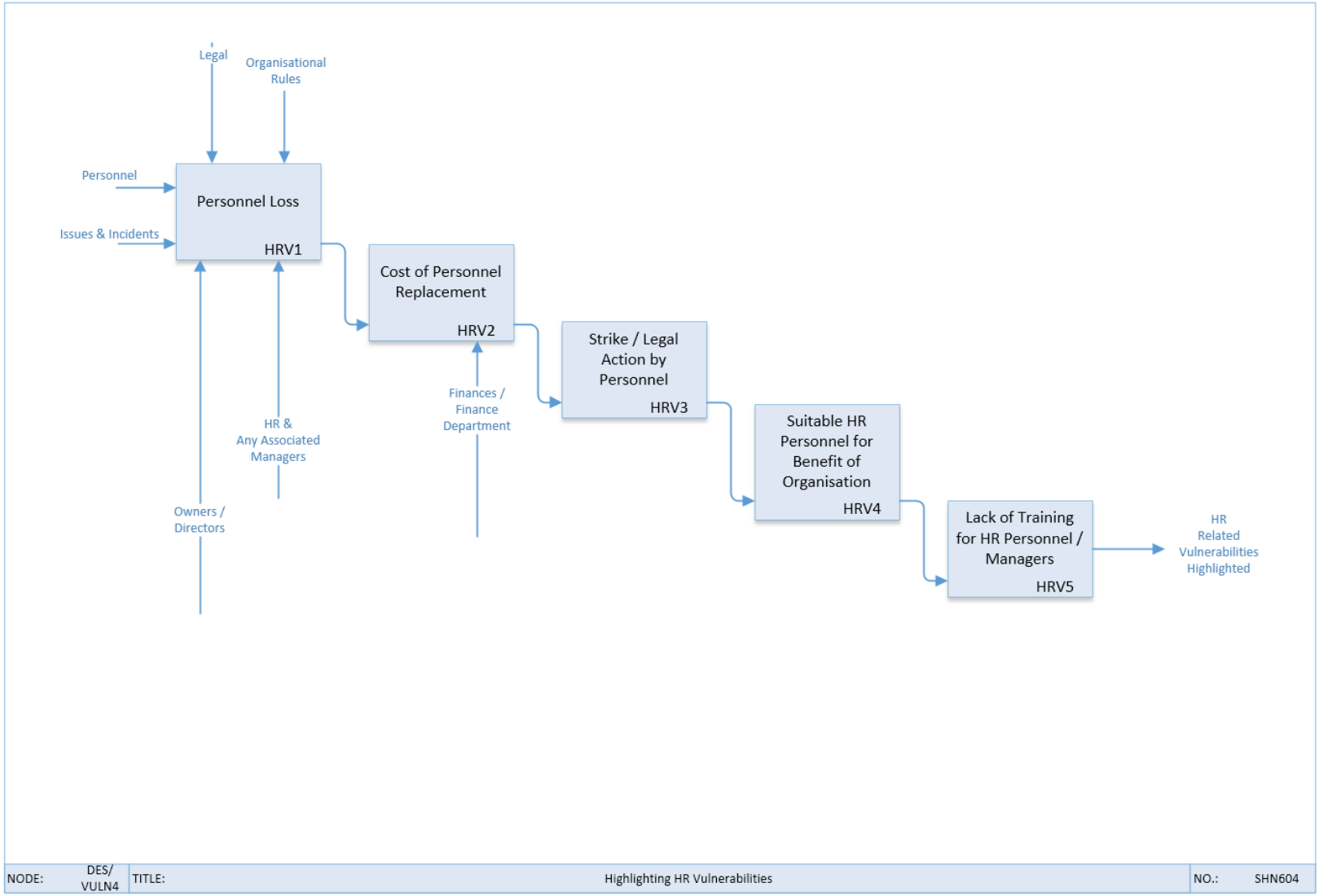


Figure 7. 24 - Highlighting HR Vulnerabilities (Author)

This roadmap incorporates the following stages:

- HRV1: Taking into consideration the potential of personnel losses, personnel issues and incidents that can lead to financial repercussions (in terms of lost output and settlements) due to legal and organisational rules, organisations (through HR and the owners) need to be aware of the possible vulnerabilities that exist in this arena.
- HRV2: Should personnel leave or need to be temporarily replaced, organisations should have provision in place to ensure the operation can continue such that organisation income is not negatively affected.
- HRV3: The organisation should make provision for potential strike action. Efforts should be made to ensure such incidents do not happen through appropriate HR policies and procedures.
- HRV4: Organisations should only employ suitably qualified HR personnel to ensure all employment issues fall within the parameters of the employment laws working within the jurisdiction of the country in which the organisation is operating. Unsuitable HR personnel are likely to prove to be a vulnerability for the organisation, making it less efficient and costing it financially.
- HRV5: Lack of training for HR personnel is an area of potential vulnerability. Through not understanding the latest issues regarding employment laws relating to employees, the potential for financial losses is present. Consequently all HR personnel need to be suitably qualified and need to partake in CPD annually.

Figure 7. 25 illustrates the Highlighting Legal Vulnerabilities Roadmap.

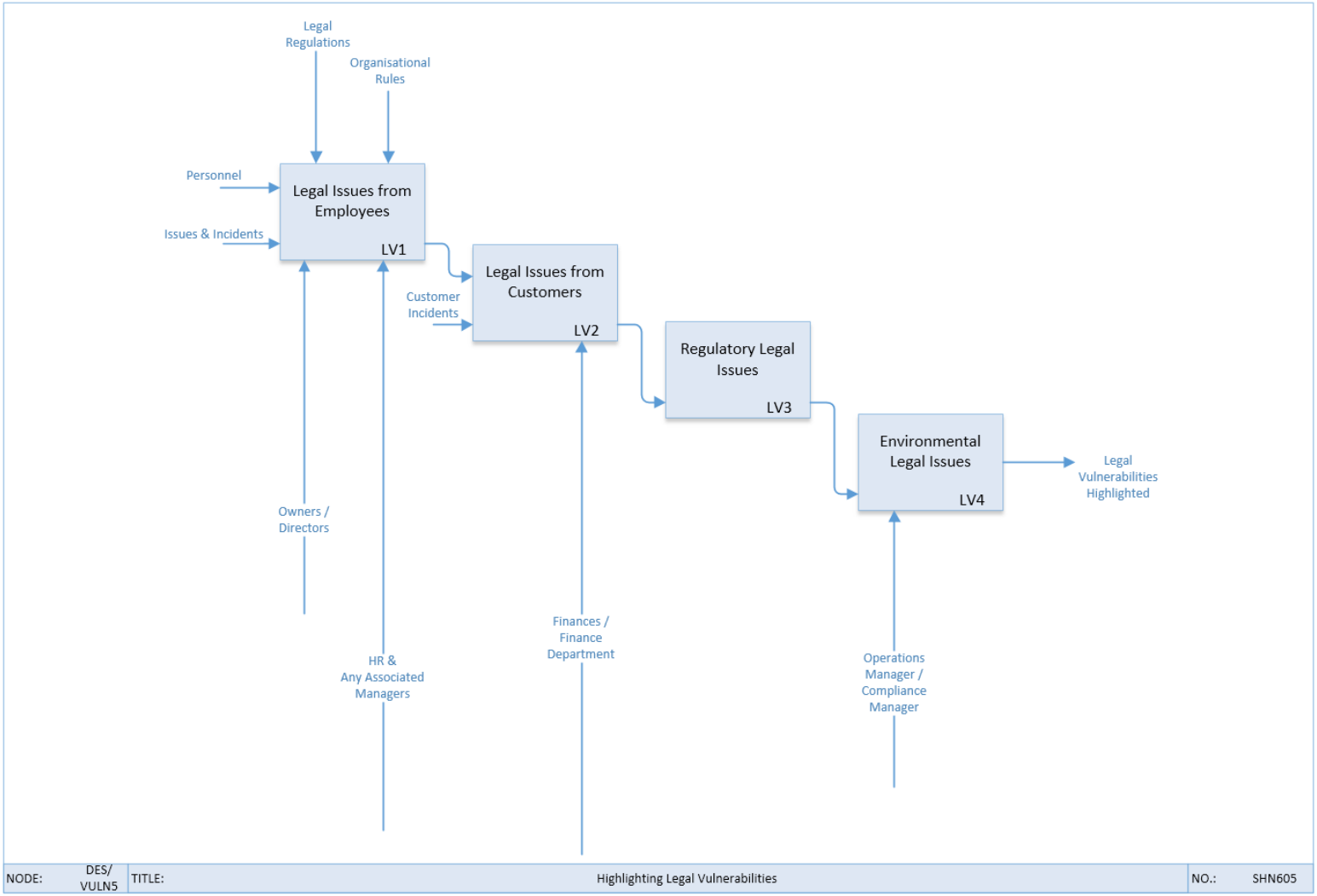


Figure 7. 25 - Highlighting Legal Vulnerabilities Roadmap (Author)

This roadmap incorporates the following stages:

- LV1: Taking into account potential legal issues and incidents from employees (in line with employment requirements and organisational rules), organisation owners and HR managers need to be aware of the potential areas in which they are vulnerable that could have a negative financial impact on the organisation.
- LV2: Taking into account sales legislation in different world markets for the products being sold, organisations need to be aware of any legal vulnerabilities that exist in relation to customers and end users of the products being manufactured.
- LV3: Organisations need to be aware of legal and regulatory issues relating to the products manufactured for each country in which they are sold. Failure to comply with such regulations could result in the organisation being vulnerable to legal action and the associated subsequent financial implications.
- LV4: Organisations need to be aware of the environmental, legal and regulatory issues relating to the products manufactured for each country in which they are sold. They should also be aware of any potential issues relating to the disposal or emissions of the said items. Failure to comply with such regulations could result in the organisation being vulnerable to legal action and the subsequent financial implications that this would bring about.

Figure 7. 26 illustrates the Highlighting Energy Vulnerabilities Roadmap.

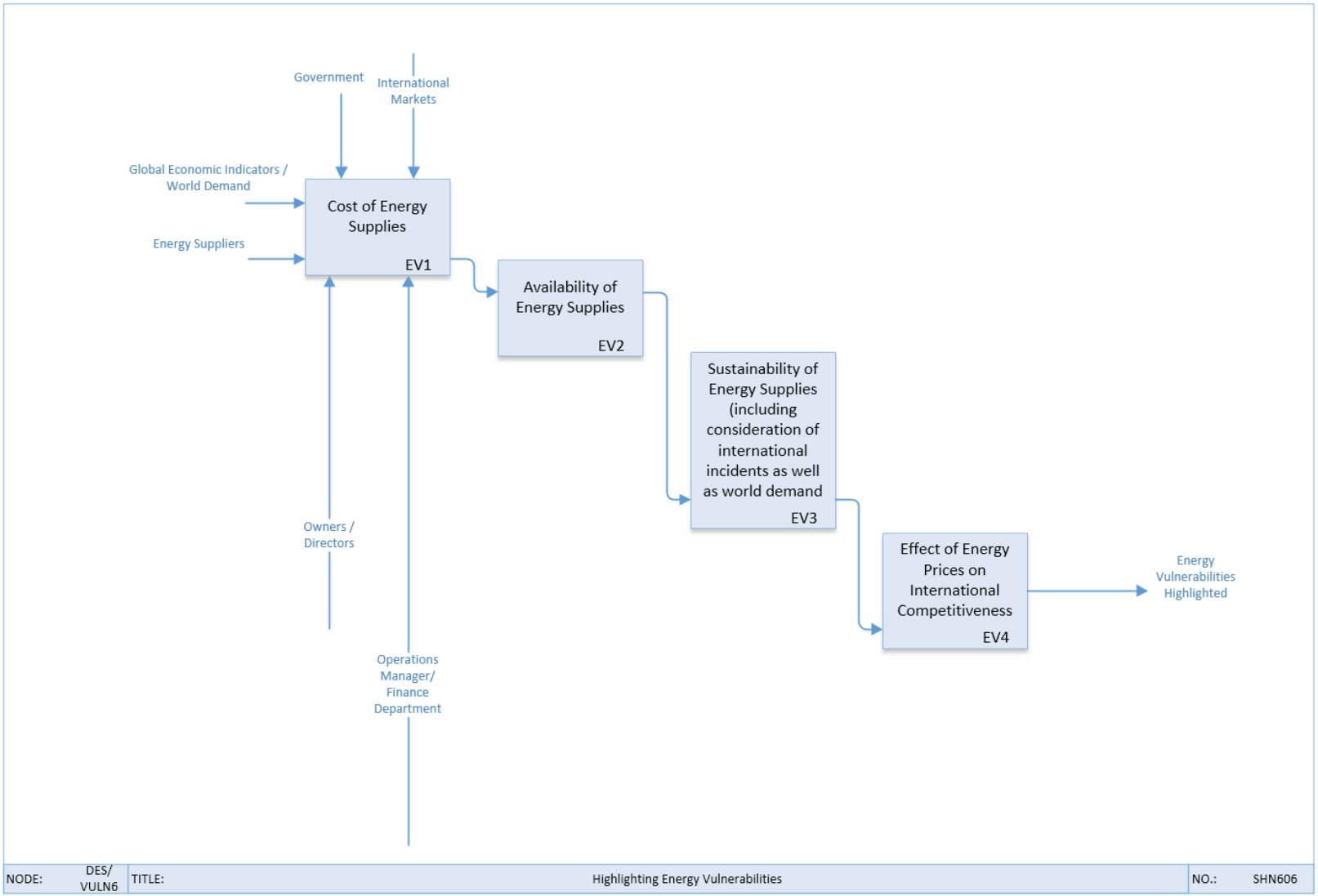


Figure 7. 26 - Highlighting Energy Vulnerabilities (Author)

This roadmap incorporates the following stages:

- EV1: Taking into account global economic and political indicators as well as knowledge relating to energy suppliers, governments and international markets, organisations should be aware of the potential vulnerabilities faced in relation to energy supply costs.
- EV2: Whilst not a significant issue for the last thirty years within the UK, organisations should be aware of the impacts associated with a lack of energy supplies and the potential impacts this would have for their organisation. Such awareness should not be limited to the UK but also to the markets the organisation sells into as well as general world demand for the available resources. Whilst it may not be possible to mitigate against insufficient energy supplies, it may be possible to have alternative forms of energy under consideration for the long-term prosperity of the organisation.
- EV3: Organisations should be aware of the potential for energy sustainability both in terms of its manufacturing base and the markets into which it sells. The impact of international incidents (both economic and political) should be of interest to all organisations from the perspective of both energy supplies and product demand. Such incidents would impact both the organisation and supply chain member financial situations.
- EV4: Organisations should be aware of the potential impact of international changes in energy prices, particularly in terms of the organisation's competitiveness. The impact of such changes should be considered in each market the organisation deals with and the elasticity of demand for the products can be considered as a means of managing the pricing of products being sold.

Figure 7. 27 illustrates the Highlighting Technological Vulnerabilities Roadmap.

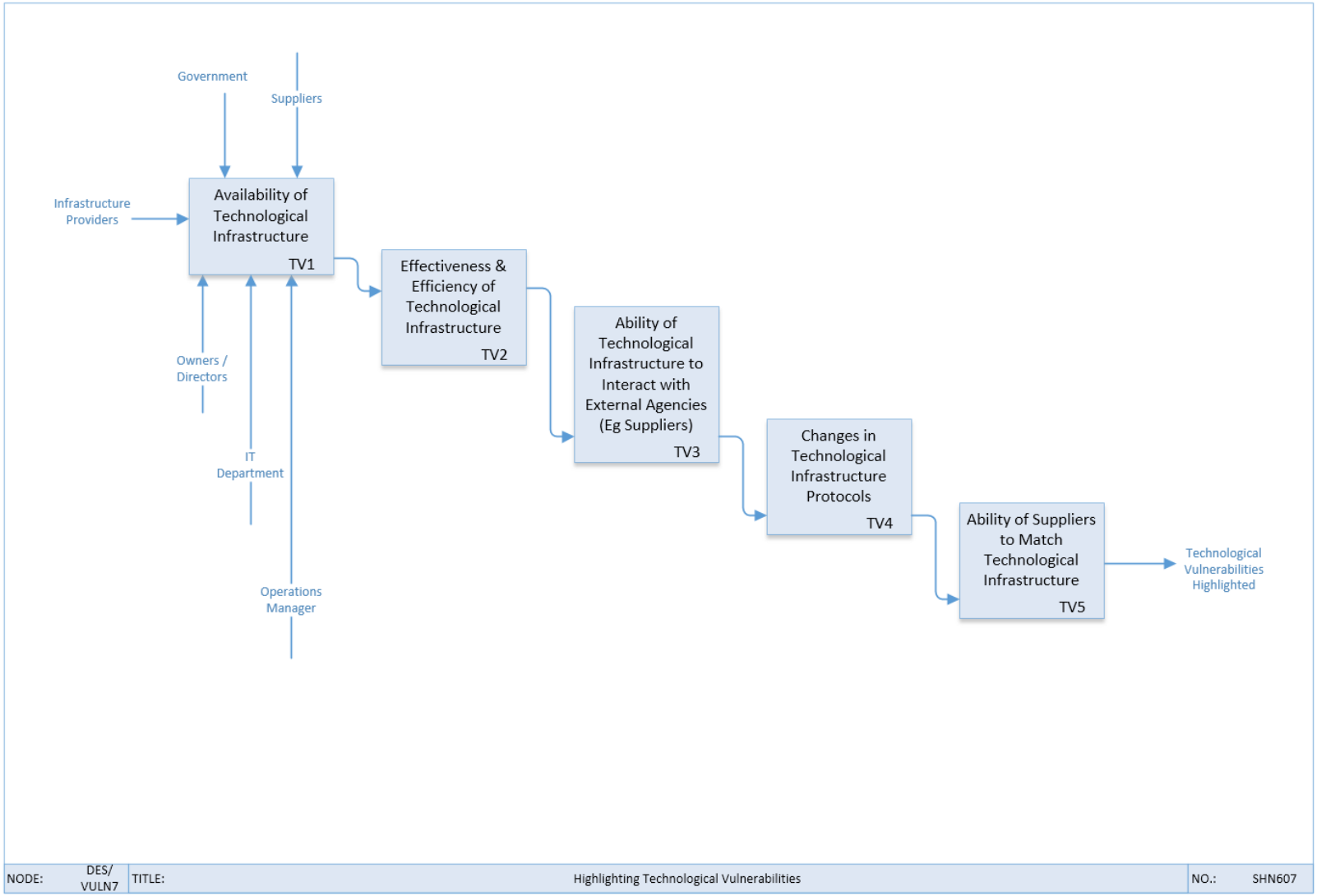


Figure 7. 27 – Highlighting Technological Vulnerabilities Roadmap (Author)

This roadmap incorporates the following stages:

- TV1: Taking into account the inputs available from technological infrastructure providers, the government and supplier regulations around which the infrastructure must operate as well as the needs of the organisation owners and managers, the present state of the technological infrastructure should be known.
- TV2: Having established the availability of the technological infrastructure, its effectiveness and efficiency should be identified to ensure the organisation can operate within its required parameters.
- TV3: The technological capabilities of the manufacturing organisation need to operate in line with suppliers and other external agencies. For example, stock ordering software must be compliant between all organisations within the supply chain.
- TV4: Any changes that take place within the technological infrastructure need to work within strict parameters or protocols for all parties within the organisation. Failure to work within these parameters is a technological vulnerability.
- TV5: Whilst it is clearly important for the organisation to operate within an effective technological infrastructure, it is also necessary for all suppliers to do the same such that the organisation in question and all other aspects of the supply chain meet all needs.

Figure 7. 28 illustrates the Highlighting Technological Vulnerabilities Roadmap.

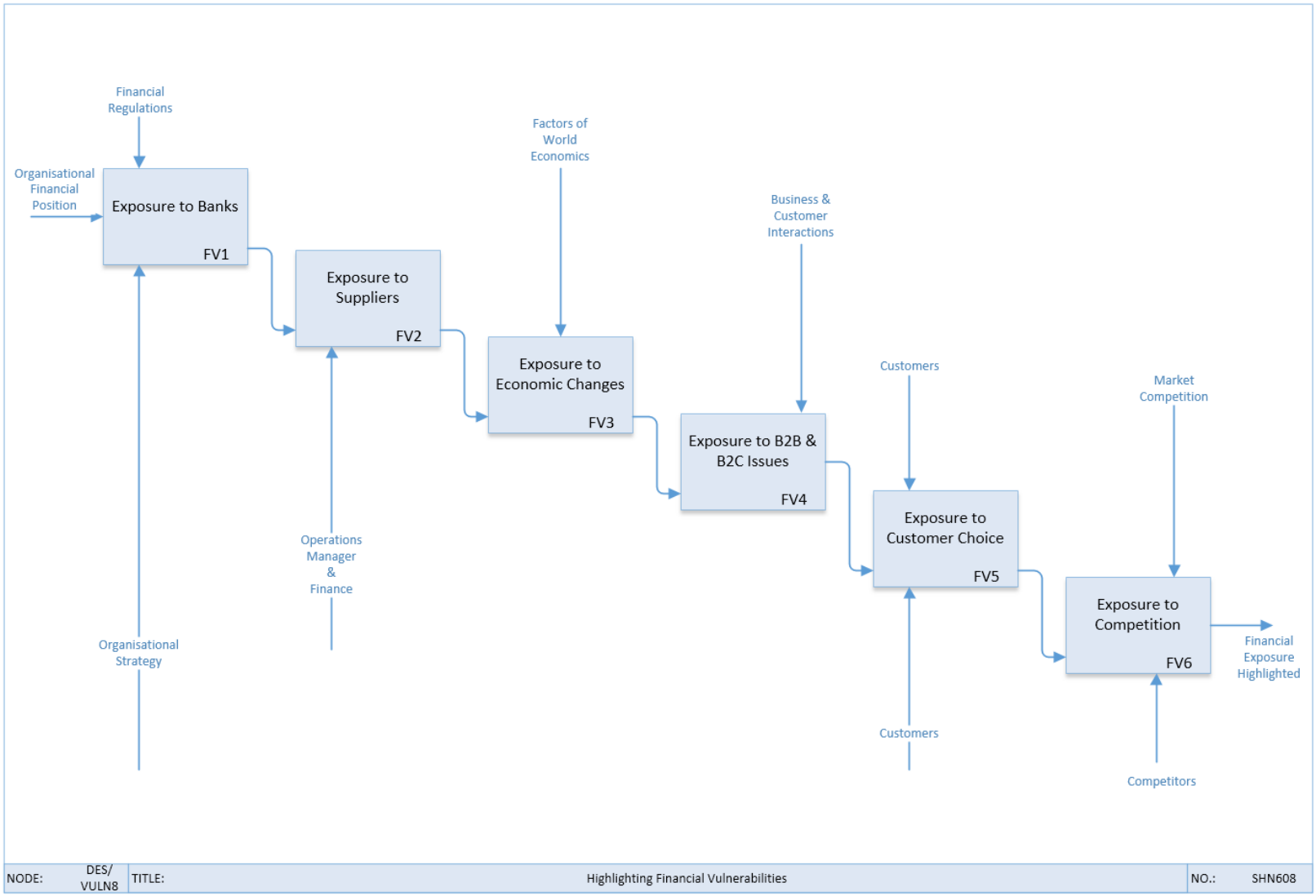


Figure 7. 28 - Highlighting Technological Vulnerabilities Roadmap (Author)

This roadmap incorporates the following stages:

- FV1: Taking into account the organisation's financial position, financial regulations that operate within the market and the organisational strategy, the organisation's financial risks and exposure to banks and other financial institutions should be clearly known.
- FV2: Based upon knowledge of stock held and the levels of credit extended from suppliers, the organisational exposure to suppliers should be known.
- FV3: Accounting for world and national economics, the organisation should be aware of its economic standing and its exposure to risks relative to any changes that can take place.
- FV4: Taking into account customer and other business interactions, the organisation should be aware of the financial risks faced relative to its exposure to Business to Business and Business to Customer relationships.
- FV5: Taking into account changes in lifestyles, technology, the product life-cycle and other such factors, the organisation should be aware of its potential vulnerabilities relative to changes in customer choice and the short, medium and long-term effects this can have.
- FV6: Whilst newly developed and launched products are unlikely to have any real competition within the market place, products that are competing against rival commodities will clearly be exposed to competitors and the effects of market competition. Any successful newly developed and launched products are likely to very quickly be exposed to market competition, thus another financial element of exposure needs to be considered by all supply chain organisations.

Figure 7. 29 illustrates the Highlighting Environmental Vulnerabilities Roadmap.

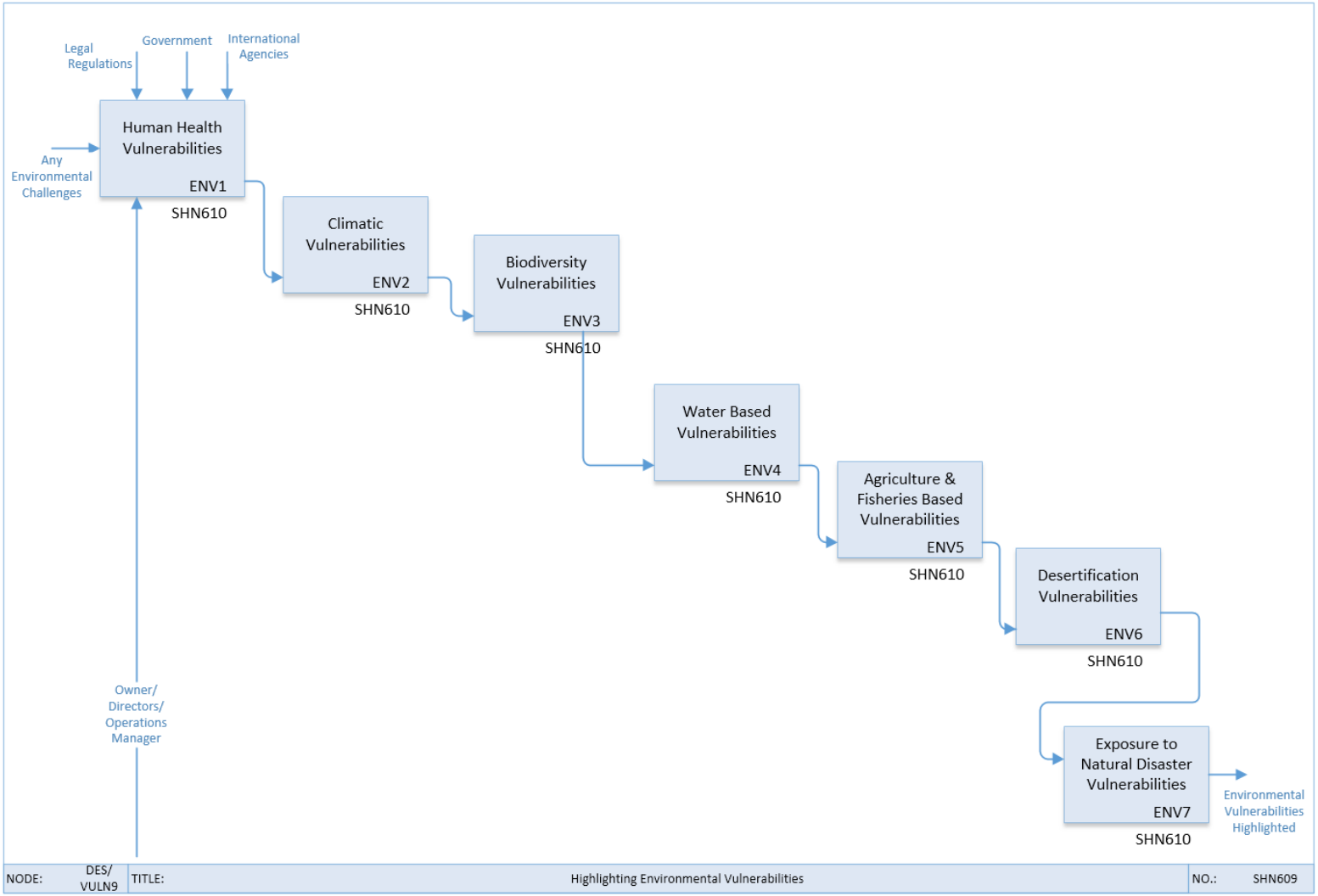


Figure 7. 29 - Highlighting Environmental Vulnerabilities Roadmap (Author)

This roadmap incorporates the following stages:

- ENV1: Taking into account internal or external environment changes as well as working regulations imposed by the government and international agencies (as well as management considerations), the organisation needs to be aware of vulnerabilities it is exposed to regarding human health – predominantly employees but also for any other stakeholders that may be impacted by the organisation.
- ENV2: Climatic changes that could affect the organisation, the supply chain, production and delivery need to be clearly known to avoid potential issues.
- ENV3: The organisation needs to be aware of the different species that its operation can affect – both locally in terms of its production operation and internationally with regards emissions and long-term issues that might arise from its operation. The vulnerability here not only exists in terms of endangering lives and living conditions, but also in terms of the potential legal ramifications that might come about following potential damage to lives and living conditions.
- ENV4: Organisations utilising water sources in the manufacturing process should be aware of water-based vulnerabilities in terms of its own supplies. Should polluted water be entering the production system, the resultant outputs are likely to be below standard and subsequently quality requirements will not be met. Furthermore, should water emitted as a result of the output process be contaminated, it will result in potential damage to the environment and wildlife. Such situations could result in legal action and financial losses for the organisation.
- ENV5: Any organisation operating within a supply chain utilising inputs based upon agriculture or fishing should be aware of the potential areas of vulnerabilities faced including issues such as pollution, climate change, disease and issues relating to the transportation of goods relative to storage and shelf-life requirements.
- ENV6: Organisations dealing with supply chain inputs such as land that could be affected by drought should have plans in place to overcome the vulnerabilities. There may also be concerns in this area with regards transportation of goods to parts of the world that are affected by drought.
- ENV7: Organisations should be aware of vulnerabilities relating to the potential for natural disasters. Whilst many cannot be avoided should they arise, organisations should be aware of issues that could affect the supply chain regarding factors such as high tides, flash floods, extreme temperatures, earthquakes and volcanoes.

Figure 7. 30 illustrates the Potential Environmental Vulnerabilities Roadmap. No further discussion is considered here due to the self-explanatory nature of the diagram.

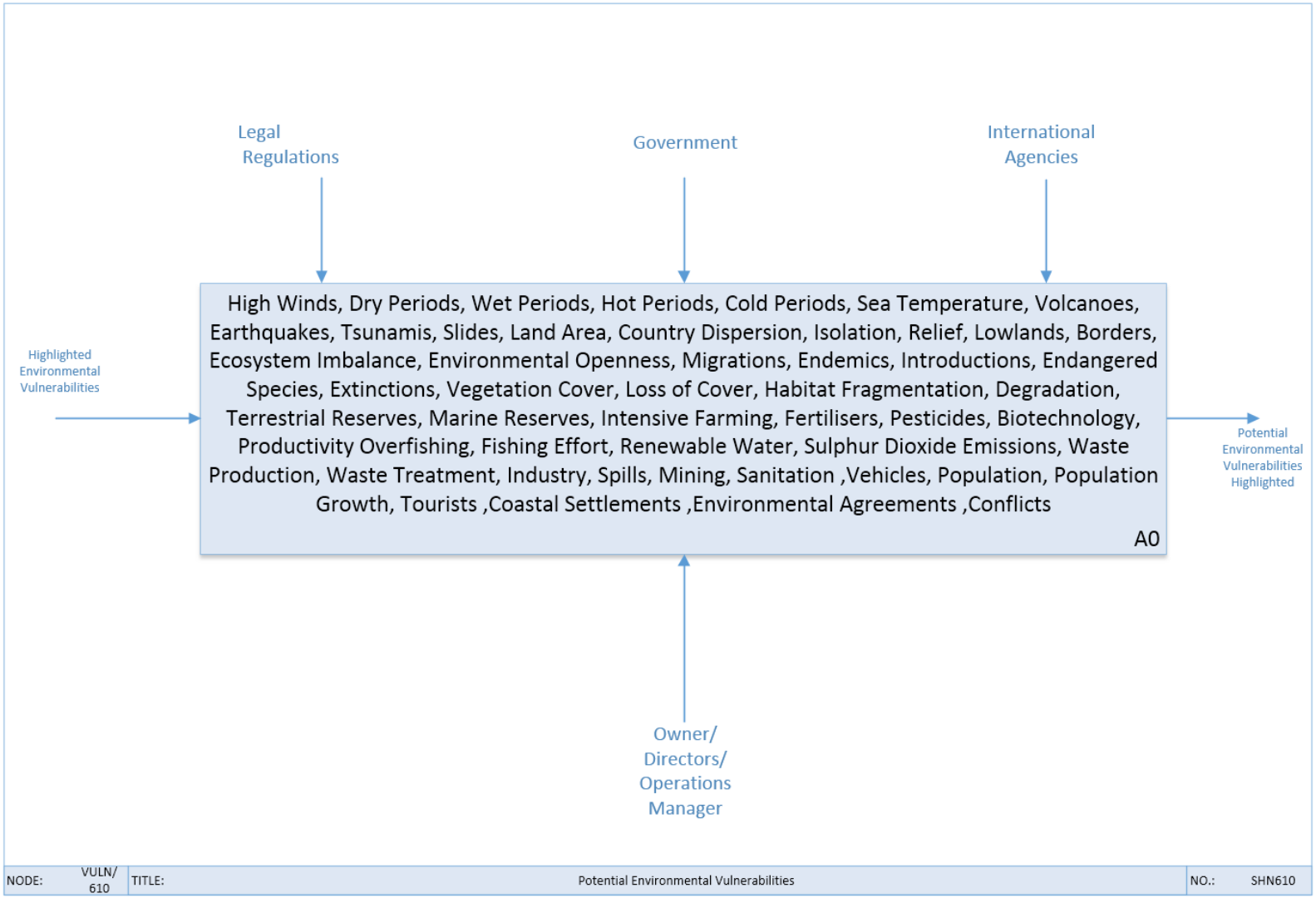


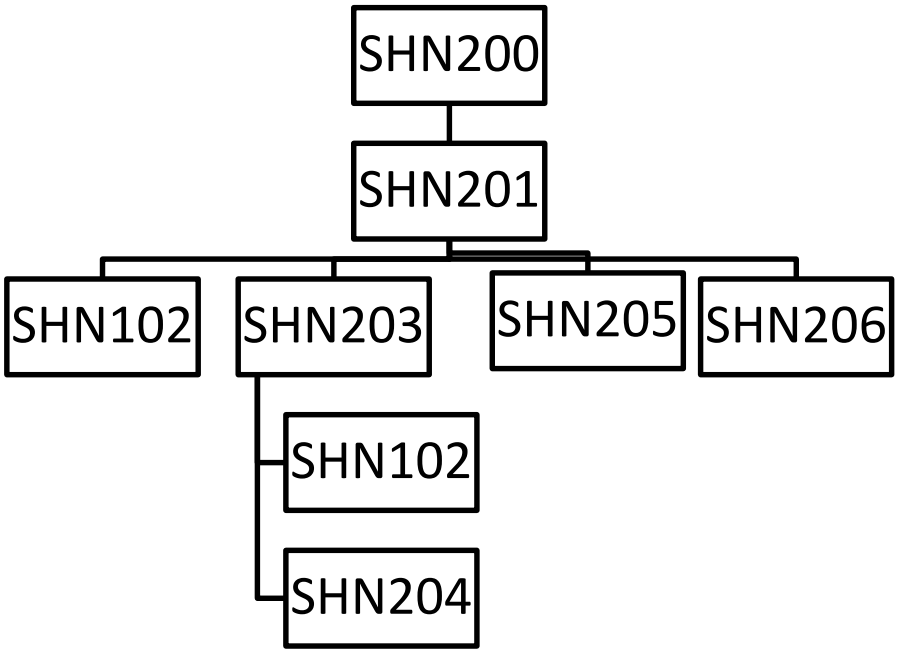
Figure 7. 30 - Potential Environmental Vulnerabilities Roadmap (Author)

7.3.4 Suppliers and the Supply Chain Roadmap Chain

Table 7. 8 illustrates the *Supply Chain Roadmap* to assist in any cross-referencing that may take place. The parent and child relationships of these IDEF0 diagrams are illustrated in Hierarchy Diagram 7. 4.

Table 7. 8 - Supply Chain Roadmap Nodes & Corresponding Diagrams (Author)

Node	Description	Diagram Number
DES/SC0	Supply Chain Roadmap Overview	SHN200
DES/SC1	Supply Chain Road Map	SHN201
DESC/SC2	Design Components	SHN102
DES/FSS2	Find Suitable Supplier	SHN203
DES/FSS3	Align Supplier Needs with Organisation	SHN204
DES/SCS1	Develop Supply Chain Structure	SHN205
DES/ISISC1	Integrate Systems & Implement Supply Chain	SHN206



Hierarchy Diagram 7. 4 - Supply Chain Roadmap (Author)

Figure 7. 31 illustrates the *context diagram* for the Supply Chain Roadmap.

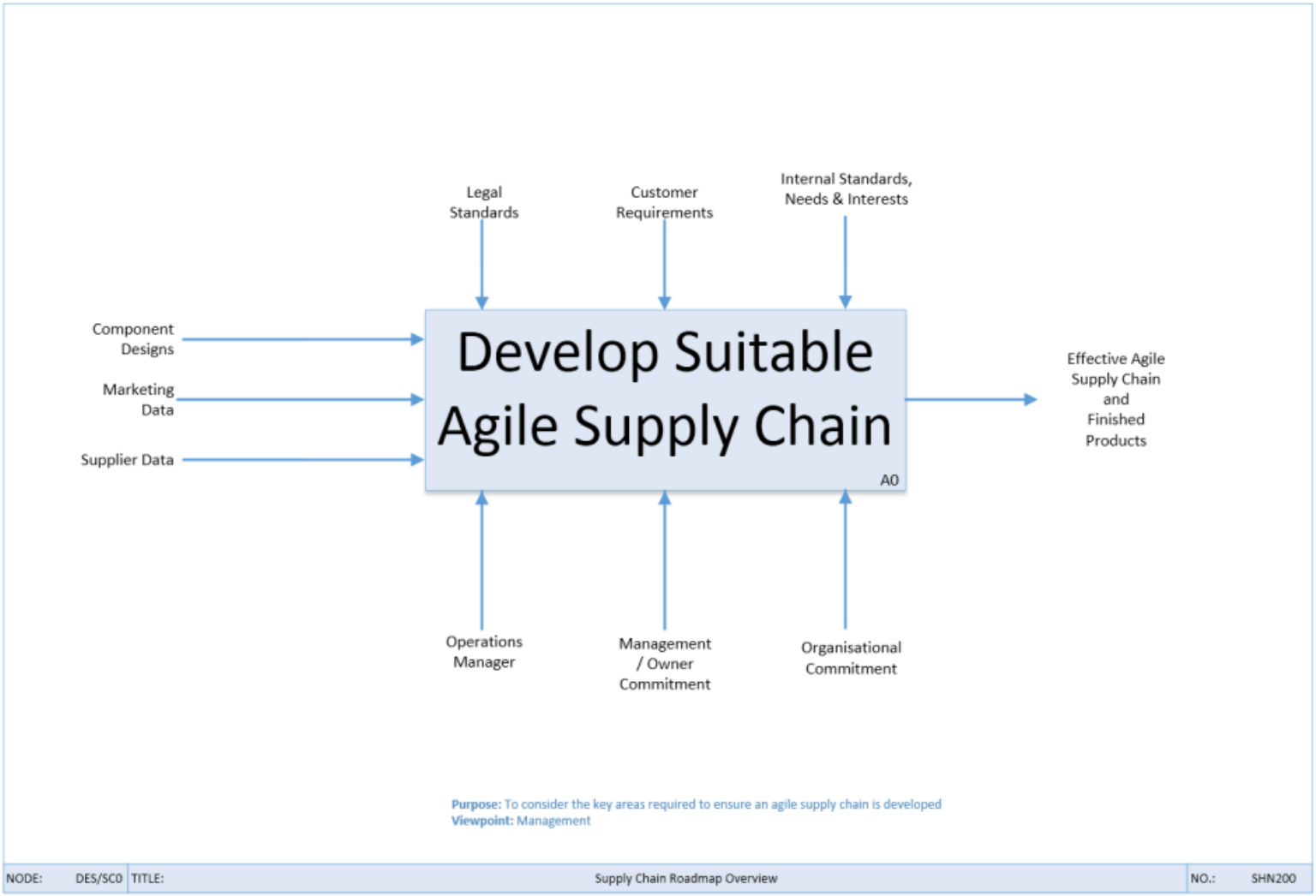


Figure 7. 31 - Supply Chain Roadmap Overview (Author)

Through taking component designs, marketing and supplier data into account, alongside legal requirements, customer demands, internal standards and management-driven goals and commitments, it should be possible for an organisation to develop an effective and sustainable agile supply chain and ultimately deliver high quality products to customers.

Figure 7. 32 illustrates the Supply Chain Roadmap.

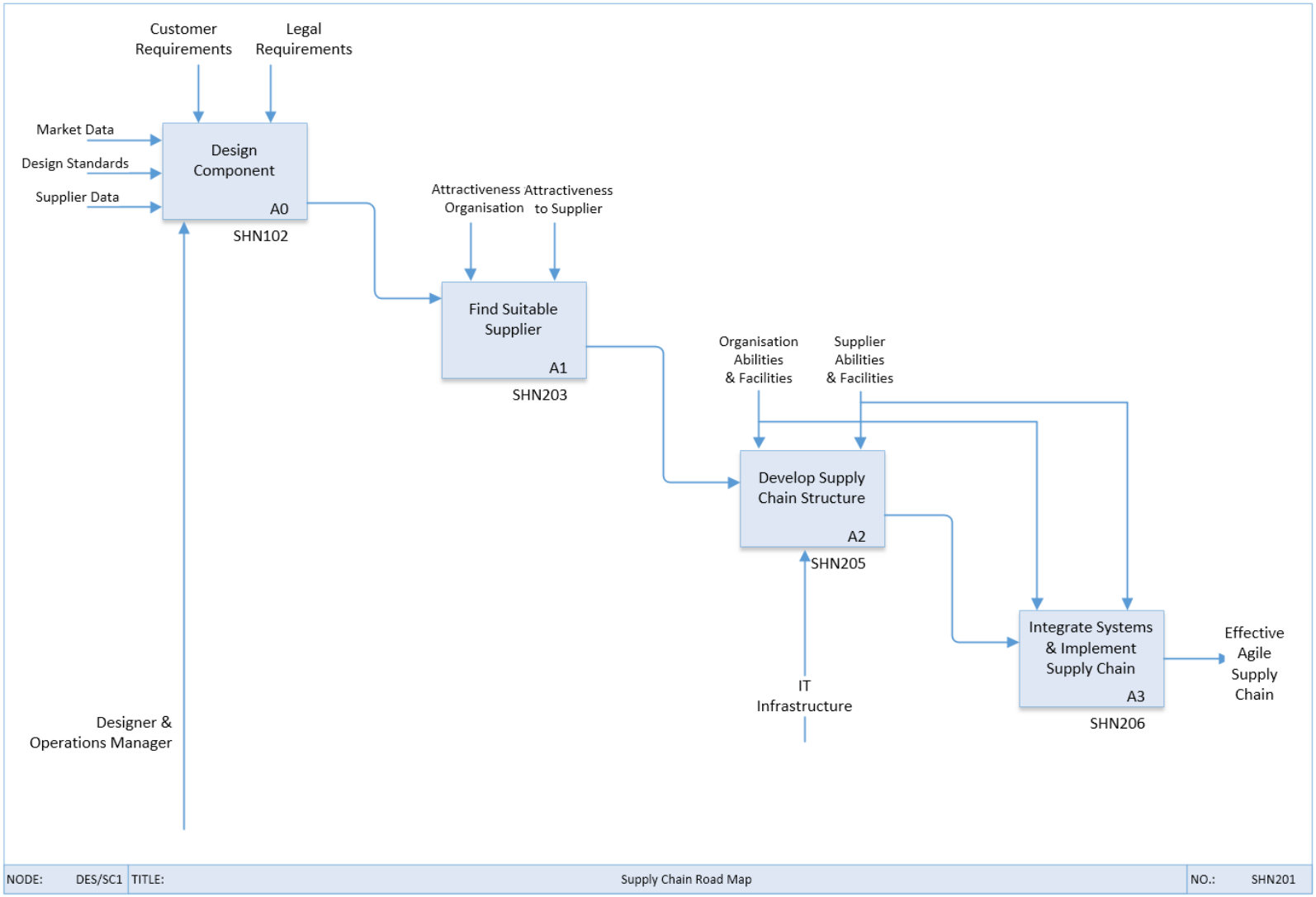


Figure 7. 32 - Supply Chain Roadmap (Author)

This roadmap incorporates the following stages:

- A0: Components need to be designed that take into account marketing and supplier data alongside design standards, customer and legal requirements and internal management overviews.
- A1: Suitable suppliers need to be found that are willing to work with the organisation in question to supply the necessary components and services as and when required. These suppliers must also be willing to share market data and work with the rest of the supply chain to ensure consumer requirements are met to safeguard the future of the supply chain as a whole.
- A3: Having found suitable suppliers, a structure for the supply chain as a whole needs to be developed taking into account abilities, facilities, IT and the general infrastructure available from the perspective of the organisation and the suppliers.
- A4: Having developed a suitable supply chain, systems between supply chain partners need to be integrated and implemented to ensure transparency exists between those involved to ensure an agile supply chain comes to fruition.

Figure 7. 33 illustrates the Design Components Roadmap.

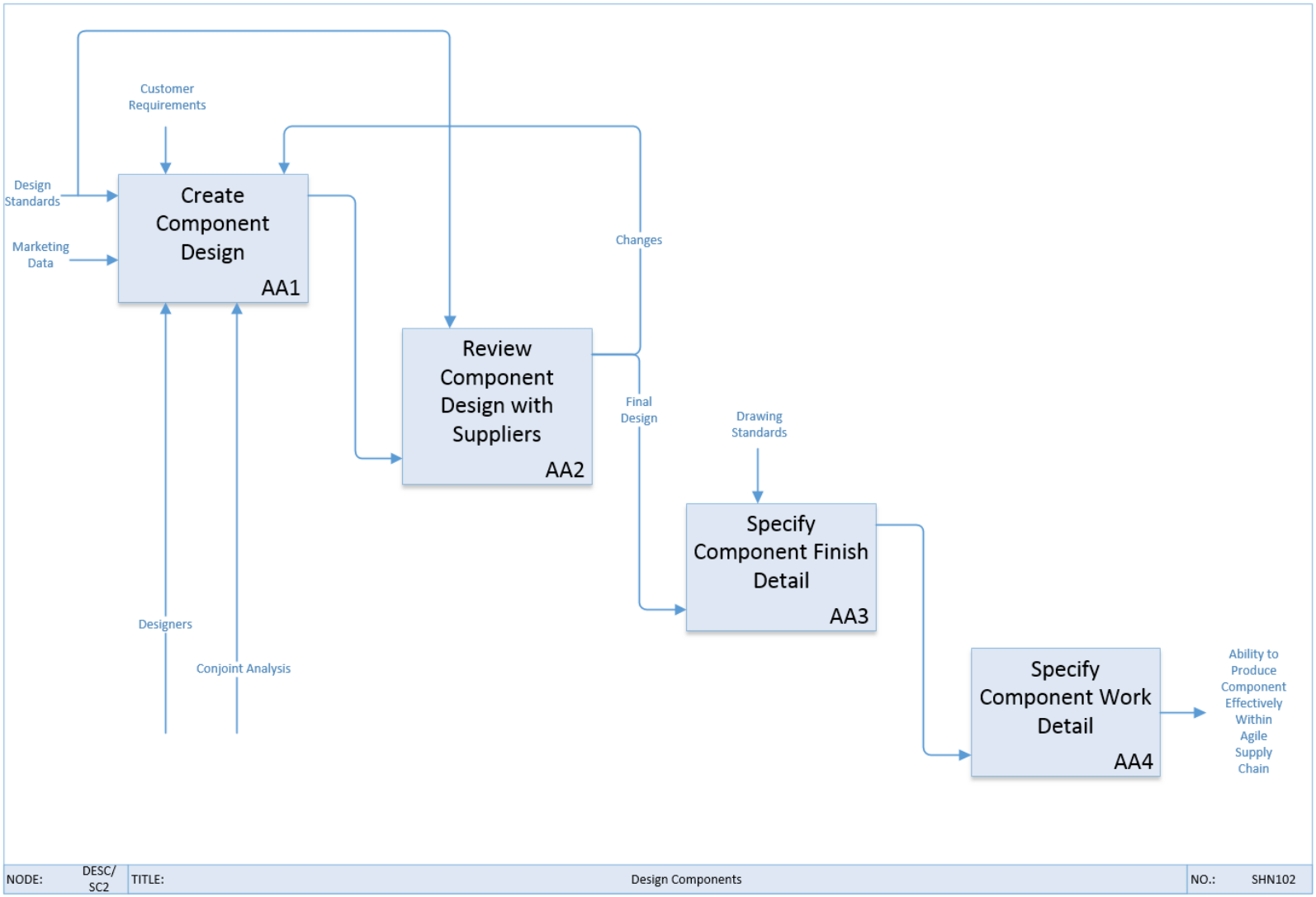


Figure 7. 33 - Design Components Roadmap (Author)

This roadmap incorporates the following stages:

- AA1: Taking into account design standards, output results from the Conjoint Analysis and marketing data as well as customer requirements and design inputs, components and products can be designed.
- AA2: Designed components and products need to be reviewed and altered in line with design standards, marketing data and customer requirements.
- AA3: Having completed the final design, component finish requirements are needed. This may come as a result of individual customer requirements on a JIT-type basis.
- AA4: Specific needs of individual components can be included within the finished products.

Figure 7. 34 illustrates the Find Suitable Supplier Roadmap.

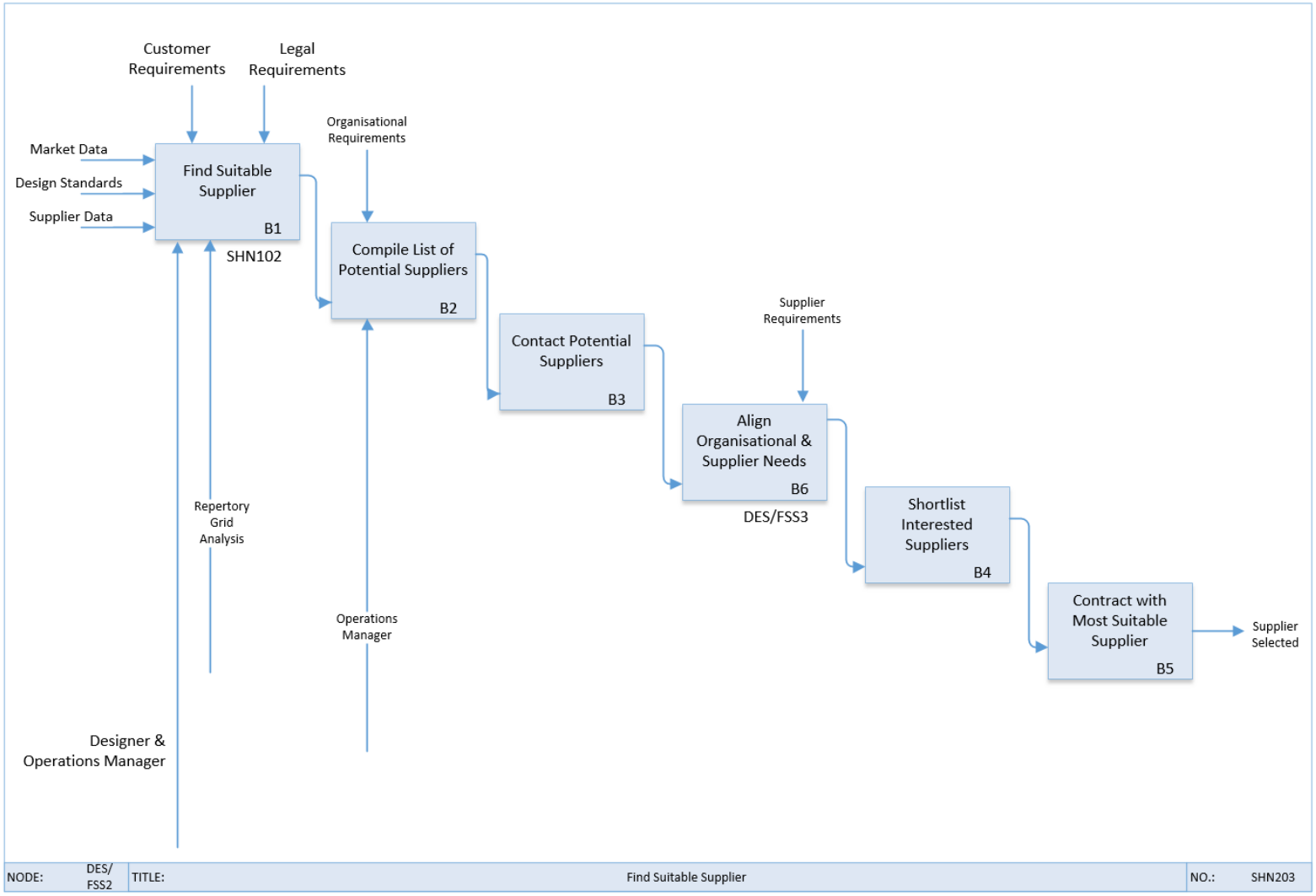


Figure 7. 34 - Find Suitable Supplier Roadmap (Author)

This roadmap incorporates the following stages:

- B1: To manufacture a given product or component, suitable suppliers are needed. To find them it is necessary to consider output results from the Repertory Grid Analysis, market and supplier data as well as design standards and customer and legal requirements (and inputs from the product designer and Operations Manager).
- B2: Having considered the organisational requirements and the experiences of the Operations Manager, a list of potential suppliers can be drawn up.
- B3: Potential suppliers from the list can be contacted to ascertain their interest and commitment levels in supplying to the project.
- B4: Taking supplier needs into account, both organisational and supplier needs can be aligned.
- B5: A shortlist of suppliers can be drawn up from interested parties meeting organisational requirements.
- B6: A contract can be drawn up and awarded to the most suitable supplier with whom an agile supply chain can be run.

Figure 7. 35 illustrates the Align Supplier Needs with Organisation Roadmap.

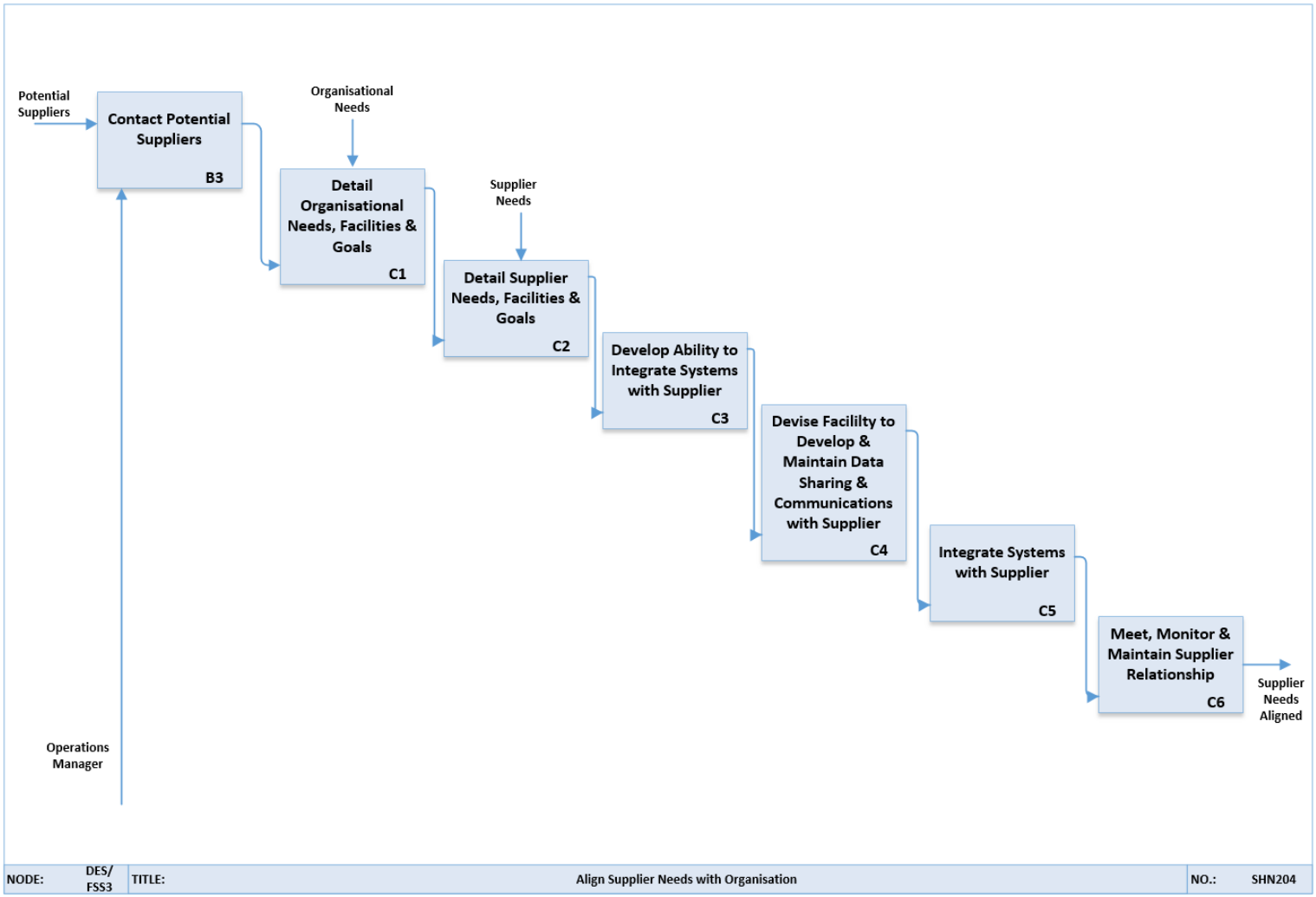


Figure 7. 35 - Align Supplier Needs with Organisation Roadmap (Author)

This roadmap incorporates the following stages:

- C1: Taking into consideration the experiences from the Operations Manager, organisational needs must be drawn up.
- C2: In a similar way to C1, the supplier needs should be drawn up.
- C3: The infrastructure between the organisation and supplier needs to be in place in terms of IT, communication, facilities, and levels of data sharing and any other areas of relevance between the parties concerned.
- C4: The technical and practical aspects of data sharing and communications with the supplier need to be established to ensure the agile supply chain runs as effectively as possible.
- C5: The systems need to be established and integrated between the organisation and supplier parties.
- C6: To maintain high levels of commitment, trust and an effective agile supply chain it is necessary to preserve communications with suppliers via data sharing and meetings such that the relationship and its effectiveness can be monitored and sustained for the long-term benefit of those involved.

Figure 7. 36 illustrates the Develop Supply Chain Structure Roadmap.

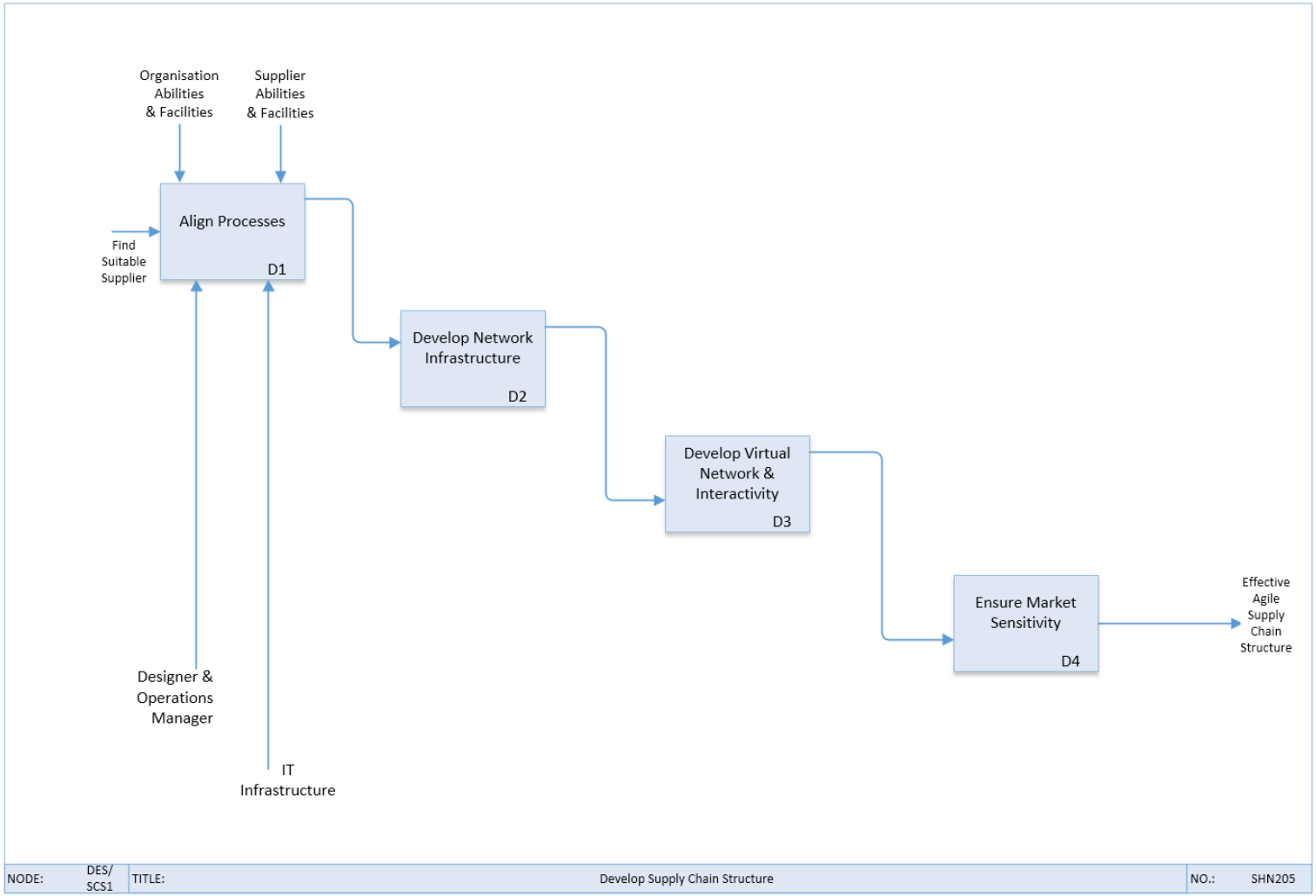


Figure 7. 36 - Develop Supply Chain Structure Roadmap (Author)

This roadmap incorporates the following stages:

- D1: Having found a suitable supplier that can meet supply chain needs, processes between the said parties must align to ensure the free flow of information and data for the long-term benefit of agility. This requires the inputs of the Operations Manager and the needs of the IT infrastructure.
- D2: Having aligned the processes between the said parties, a network infrastructure needs to be established.
- D3: With the network infrastructure established, the agile supply chain members can interact virtually without the need to continuously meet and ascertain information.
- D4: Data sharing can now take place due to the network infrastructure and virtual interactions between the associated parties. The supply chain as a whole can monitor the market for changes and trends and thus align the agile supply chain to market demands.

Figure 7. 37 illustrates the Integrate Systems and Implement Supply Chain Roadmap.

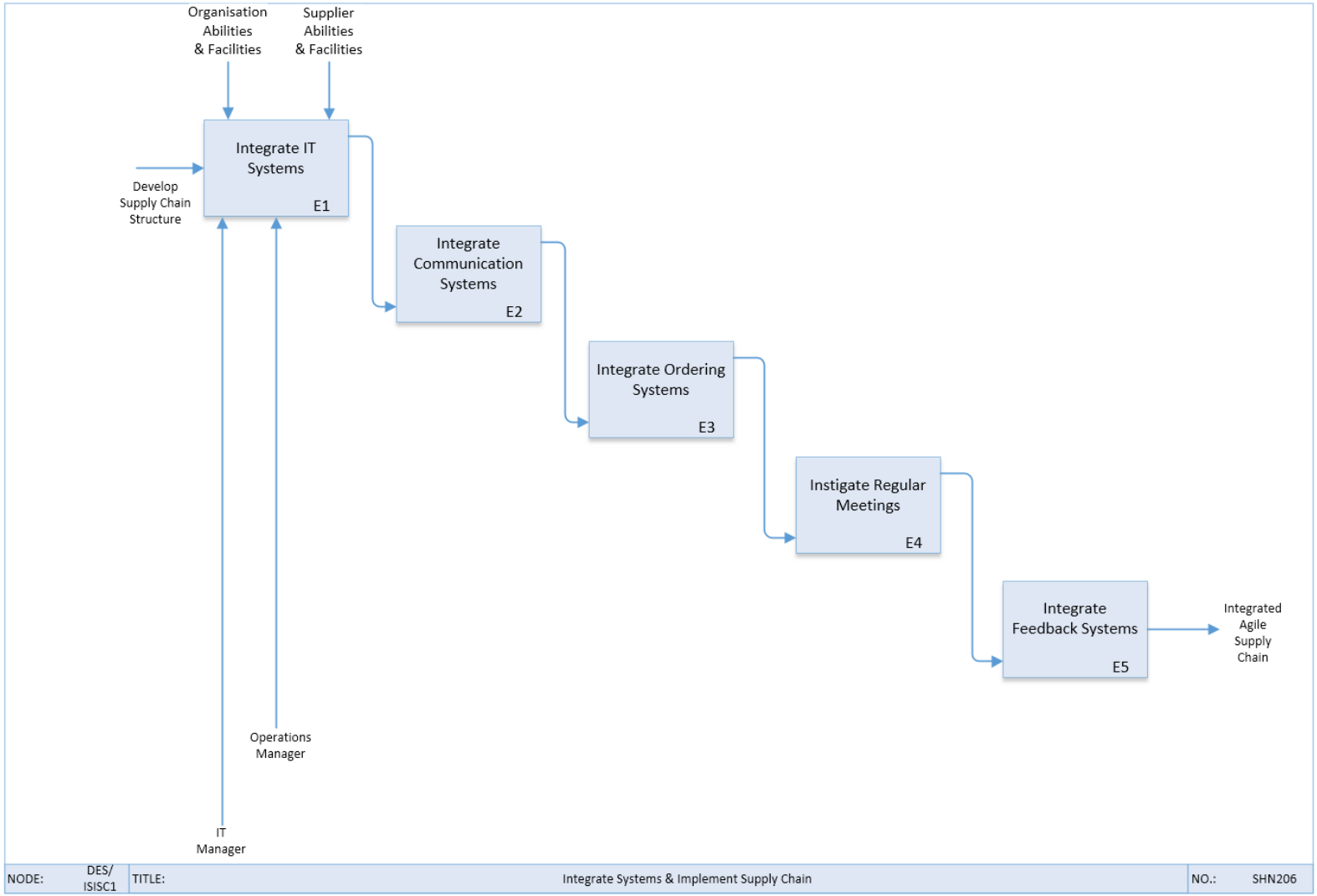


Figure 7. 37 - Integrate Systems and Implement Supply Chain (Author)

This roadmap incorporates the following stages:

- E1: Having established the basis for the agile supply chain (in line with the organisation and supplier abilities and the needs of the IT and Operations Managers), inter-organisational IT systems can be integrated.
- E2: Standards and systems for inter-organisational communications can be established to ensure the free and effective flow of information.
- E3: Having established the IT and communications systems between the organisation and suppliers it is necessary to establish a clear system for stock ordering such that market data and the needs of supply chain members are evident for all partners to see.
- E4: To maintain strong, on-going relationships, regular meetings between all parties should be established.
- E5: To ensure openness between supply chain partners, a means of feedback between all involved parties should be established to ensure high quality needs are met for the long-term benefit, competitiveness and survival of the supply chain.

7.4 Roadmap Summary

Having established the outcomes from the *PFS Model*, an organisation wishing to develop its agile supply chain can utilise the roadmaps presented in this chapter. The roadmaps are generic and in principle applicable to all SMEs. For total applicability, this methodology needs to be considered in line with the needs of the individual organisation and adjusted accordingly. The achievement at this juncture therefore is the development of a universal roadmap model that can be taken forward by organisations to develop into more bespoke tools to specifically meet their requirements to develop their own effective agile supply chains.

The development of the roadmaps has therefore completed the cycle that was started from the questionnaire-interview, progressed into the *PFS Model*, from which relevant results were appertained and from which an operational direction can now be established (as illustrated in Figure 7. 38).

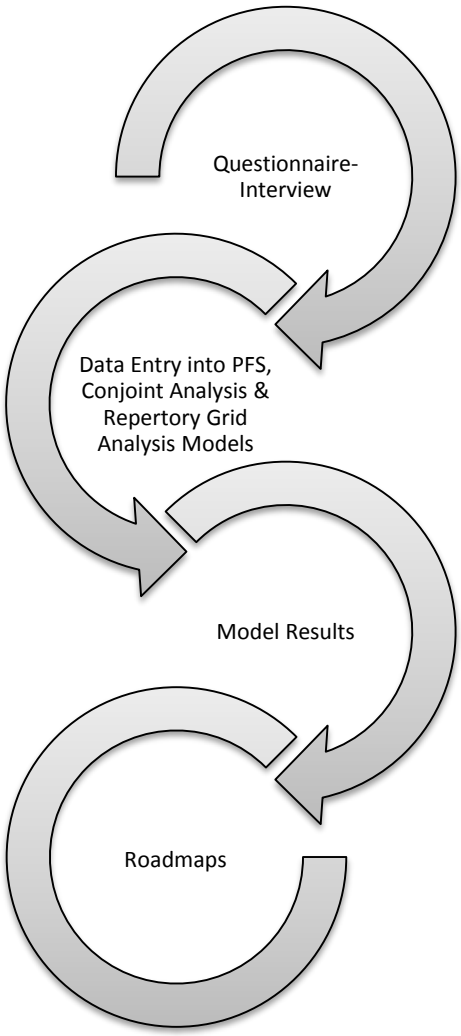


Figure 7. 38 - Cycle of Roadmap Development (Author)

8.0 Conclusion

This chapter provides a summary of the findings in the context of the objectives presented in the introductory chapter which are based upon the research gap that highlighted the changing world economic issues businesses in general face, and the supposition that agility and agile supply chains can assist SMEs in particular in their challenges. The research gap further highlighted the need for tools to recognise the present operating state of SMEs alongside the need for instruments to identify product features and potential supply chain partners to build agility into supply chains. This chapter also considers the contributions to knowledge and practice as well as a summary of the key results. Reflections on the research limitations are also presented before concluding with consideration of areas for future research. Prior to this, a chapter overview is presented.

8.1 Summary of Chapters

The Literature Review considered the business environment, the agility concept and the integration of agility into supply chains, alongside product and partner requirements. It highlighted further work proposing the need for agile supply chain frameworks and the additional need to develop them from being strategic tools used predominantly by large organisations to models that can assist SMEs in their future competiveness.

The Theoretical Framework chapter considered the background to the conceptual framework, the concepts and theories behind the PFS Model and the development of the model itself into which data would be entered. It also highlighted the Conjoint and Repertory Grid Analyses and their functionalities as supporting tools for the PFS Model.

The Methodology chapter reflected upon the methodological approach taken alongside the research philosophy, the philosophical paradigm, strategy, process and planning. Further discussion considered the data collection and sample identification methods selected and the basis for the questionnaire design. An overview of the data validation process was considered alongside research limitations and challenges as well as ethical concerns.

The Findings chapter provided qualitative findings as well as individual SME and aggregated overviews of the quantitative case study and PFS Model data. These outputs were analytically considered in the Discussion chapter alongside the theoretical ideas, concepts and propositions targeted in the Literature Review and Theoretical Framework chapters.

Further to the literature and case study data identifying the need for supportive implementation tools, without intending to validate the PFS Model, the Roadmap chapter presented a proposition to assist future research and fulfil the final element of the agility development process for agile supply chains in SMEs based upon the IDEF0 format.

8.2 Review of Original Objectives

This thesis has been centred upon agility and agile supply chains within the context of SMEs, setting out to understand how SMEs can maintain their competitiveness with regards their supply chains, product feature innovation and production. Three key objectives were set at the start of the thesis:

- **Objective 1 -** To theoretically and empirically explore the idea of agile supply chains in the context of SMEs. This will involve the exploration and extension of agile supply chain frameworks for SMEs, to examine their benefits or otherwise, and to ultimately test this through case studies.
- **Objective 2 -** To develop an integrated framework for agility and agile supply chains such that a methodology can be devised to assist SMEs in adopting agile supply chain approaches. This will be tested empirically through the use of case studies, which in turn will show how the offered model may assist strategic decision making in SMEs. This strategic decision framework theoretically integrates three key dimensions including the firm, its supply chain and the products being innovated and developed.
- **Objective 3 -** To utilise and develop supporting tools to assist the strategic decision framework (simplified for use by SMEs). These will include qualitative tools and an approach to assist SMEs via a roadmap model.

The subsequent key questions associated with these objectives are:

1. How should agility and agile supply chains be defined and understood within the context of SMEs? The question will extend to the identification of existing integrated frameworks for resilience, agility and agile supply chains that might be considered for SME adoption.

This question was considered important due to the sizeable number of definitions assigned to the agility and agile supply chain concepts and the lack of theories, strategic and operational tools available to assist in their implementation within SMEs.

2. What considerations are required to operationalise the concept and provide practice-oriented views to implement agile supply chains in SMEs? Subsequently, what supporting tool should be developed to assist SMEs in the development and management of their strategic decision making process?

Published key agile supply chain framework models were considered as the foundations from which to build a practical tool to support and develop SME agile supply chains. Accordingly the PFS Model was developed, supported by the Conjoint and Repertory Grid Analyses models to assist in this strategic decision making process.

3. How are such methods and tools perceived by SMEs (and their relevant supply chains)? This is a question of validating existing works and the proposed approaches in this work, and how they impact upon the sustained competitiveness of SMEs.

The developed models were tested at SME case study organisations, providing relevant output data to participants and the means with to practically develop their agile supply chains. All contributing organisations acknowledged the accuracy and relevance of the said models and in the case whereby the entire process was fully implemented, the impact results proved to be highly positive. For those organisations that did not implement the model, the outputs provided a new perspective on the opportunities and benefits that agile supply chains could provide for their businesses in the future. The end result hereby being that in a number of cases, the case study organisations are considering adoption and implementation of the models.

8.3 Contribution to Knowledge and Overview of Research Findings

The main contribution of this work is to agile supply chain management within the field of Operations Management. It builds upon the work of Ismail *et al.,* (2006), Ismail and Sharifi (2006), Sharifi *et al.,* (2006), Ismail *et al.,* (2011)., Sharifi *et al.,* (2013) and performance measurement frameworks, openly acknowledging the challenges faced by SMEs in their agile supply chain management and product development.

The work provides a practical framework (PFS) model with which to address such challenges. The PFS Model contribution provides the wherewithal for an SME to identify its relative strengths and weaknesses and consider prospective strategies aligned with the supply chain as a whole (in line with Ismail *et al.,* 2011 and Sharifi *et al.,* 2013). Qualitative data emanating from the model data gathering process further identifies benefits agile supply chain development can potentially provide to smaller SMEs on a macro level, affording the potential for future adaptability in turbulent markets.

Significantly, the contribution herein addresses the points regarding the limited research conducted within SMEs and their adaptability (thereby addressing Herbane, 2010). It also expressively identifies the operating attitudes towards adaptability illustrated by small SMEs – approaches that could be adopted by many organisations as a means of preparing for the future.

Following this there are two key elements to the research findings. Principally, the research substantiates and validates the use of the PFS Model (and the supporting Conjoint and Repertory Grid Analyses, which align with Sharifi *et al.,* 2006 and Sharifi *et al.,* 2013) to identify the present operating state of SMEs, further to which agility can be practically implemented through using an implementation tool such as the proffered *Roadmaps* (in line with and building on from Ismail *et al.,* 2006 and Ismail *et al.,* 2011). The roadmaps are built around the key areas within the PFS Model that are underpinned by the concepts, models and theories considered within the Literature Review and Theoretical Framework chapters, as indicated in the Discussion chapter. In these regards, the work provides a model that has hitherto not existed (thereby addressing the points made by van Hoek, 2005; Jain *et al.,* 2008; Vinodh and Prasanna, 2011; Sangari *et al.,* 2015) that can be further utilised to support the Four Dimensional Factors of Attractiveness (Sharifi *et al.,* 2009).

Secondarily, the findings present a notable point of interest, potentially offering a different slant on the agility horizon. Within the Literature Review it was argued that whilst some SMEs hold certain advantages in terms of reduced bureaucracy and adaptability (Sullivan-Taylor and Branicki, 2011) that make them less vulnerable, larger organisations hold advantages over SMEs in terms of mass production, finance and supplier relationships (Vargo and Seville, 2011). Arguably these advantages may endure, yet such a case fails to take other arguments considered in the Literature Review into account regarding change.

Arguments suggest that agility and agile supply chains are the necessary tools to help cope with the on-going and ever-increasing speed at which econometric, technological, market and social changes take place around the world. Traditional arguments suggest larger organisations are better positioned to adapt to these situations, yet based upon these findings, the opposite appears to be the case - larger organisations are less well positioned than their smaller counterparts to take advantage of them. Whilst all participating organisations hold SME status, it is the smaller companies that negotiate or at least work most flexibly with suppliers, are most proactive in product design, flexible with stock and production, and work most closely to meet customer needs, acknowledging that failure to do so brings about consequences. Evidence herein suggests that the smallest SMEs are aligning themselves more readily to insecure, external environment factors and supply chains to improve their operational methods (in line with Hallavo, 2015).

The resulting argument herein is that larger SMEs (and potentially those extending beyond SME status) need to adapt to market forces in the ways the smaller SMEs do, operating in a more bespoke fashion. Such a case requires further research to be fully substantiated, but the operating nature of the smaller SMEs indicated herein more readily meets the requirements of the changing markets.

8.4 Main Conclusions of the Research

Supply chains have historically been under the control of larger manufacturers within the chain, and changes in international markets provide new challenges and a fluctuating future for both manufacturers and supply chains. The main conclusions deriving from this research are:

- Smaller SMEs access and apply operational data more readily than their larger counterparts, improving efficiency and building their agility. This can present opportunities for such organisations to adopt advanced approaches to managing their supply chains and to overcome limitations they are associated with. It can also provide them with new opportunities for growth and success.
- Smaller SMEs operating in more bespoke systems are more suitable to being agile and developing agile supply chains than their larger counterparts. This presents opportunities not only for SMEs operating in this way, but for future business start-ups who have historically been seen to be disadvantaged relative to their larger competitors. Such companies will arguably be better suited and more adaptable to the changing and challenging international markets the future holds.
- The needs and requirements of smaller SMEs working closely with customer needs and requirements are more aligned to agility than those operating on a more mass-production basis.

- Smaller SMEs are more aware of and identify with their product features more readily than their larger counterparts, enabling them to change features to align with market requirements swiftly and more easily. This is advantageous in terms of meeting market demands, cost and lead-time reduction. In meeting market demands, businesses should be aware of both the market needs for products and of products becoming obsolete from the marketplace perspective. Those businesses failing to recognise this position continue to manufacture and extend their costs, which are unlikely to be recouped. Market knowledge and swift market alignment halts manufacture of such products and ends the associated manufacturing costs, enabling investment to turn to new products and product features, thus potentially allowing them to be brought to market ahead of competitors. At such a point, a company is potentially in the position of gaining market share on competitors. Aligned to this, lead-time reduction is significant as the ability to change swiftly and deliver new products to markets ahead of competitors provides both financial and reputational benefits.
- SMEs aligning themselves with suppliers and supply chains for product development are those that are most closely aligned to market needs, and potentially those that are most flexible in terms of agile supply chain development. SMEs attempting to build closer relationships with their supply chains are therefore more likely to become more agile, and gain from the subsequent benefits that derive from this.
- Most SMEs have ineffective and inefficient IT systems that in most instances are stand-alone and not integrated with suppliers. To develop their agile supply chains, IT systems upgrades are required to enable integration and promote information sharing and dissemination. This in turn should promote trust, information sharing, cost reduction and help to eliminate uncertainty.

Such points suggest that the smaller SMEs are naturally more adept at agile operations, and may in fact be more advanced in it than larger organisations, bringing into question arguments by authors such as Quayle (2003) who suggested otherwise. Whilst small SMEs have little influential power over suppliers, their natural *modus operandi* provides a different mind-set that overcomes many shortcomings and aligns closely with the needs of agility.

8.5 Practical Implications for Industry

As previously stated, the objectives for this thesis have centred on the development of a tool to assist SMEs in the adoption of agile supply chain approaches, and to develop and utilise the said tool to assist SMEs in becoming more strategic in their approach to business. It has also been intended that the adoption and development of agile supply chains would in turn assist in their sustained competitiveness.

From the perspective of industry, the research outputs herein provide a practical tool from which SMEs can identify their present operational standing relative to their product features and potential supply chain partners. Supporting this, a potential roadmap for agile supply chain development has been presented. Whilst this model has only been fully implemented in one organisation, the differences made have been shown to be significant. The potential interest from other partaking case study organisations is also positive for the future.

Given the positive position this presents, this research has the potential to be practically extended and employed in industry. Whilst the 600% increase in sales *Organisation G* experienced is large and cannot be guaranteed for other companies, such a significant increase in sales indicates that the model provides the potential to assist SMEs in agile supply chain and strategic development. Such results also suggest that the model can assist in helping to sustain competitiveness.

On a larger scale (and clearly one for the long-term future), if successful on a wider scale, the model has the potential to assist start-up SMEs and stabilise those facing challenges. It also has the potential to help SMEs compete more directly with larger companies around the globe – something of importance given the unpredictable markets it has been suggested are faced in the future (Mehralian *et al.,* 2013).

8.6 Limitations of the Research

The methodology was designed to try to ensure that the study was as comprehensive as possible. Despite this, certain limitations arose during the research process.

A primary limitation related to finding SME organisations that were suitable and willing to partake in the research. This was further complicated by the number of companies that were not necessarily wanting to develop agile supply chains from the outset. As highlighted in the Discussion chapter, once the research outputs were explained and presented, most organisations became more interested in the potential to take the matter further in the future and consider agile supply chain

development as the strategic benefits were evident. The initial lack of interest in agile supply chain development was therefore not a long-term issue.

Whilst this proved to be challenging, once case study organisations meeting the requirements had joined the study, the most notable limitation arose from the perspective of data gathering. It was assumed that all organisations would be able to provide data and answers to all relevant questions. This was proven to not be the case with regards the Conjoint and Repertory Grid Analyses. Whilst a concern during the early part of the data gathering process, it provided evidence for discussion and categorisation, and ultimately assisted in the overall outcomes.

Another notable concern arose regarding case study interpretations of aspects of the data. The Conjoint Analysis required data inputs relating to product features. It was assumed that such features would relate to individual products, yet *Organisation F* provided features that appeared reasonably generic. Despite checks, assurances were given as to these features, which were subsequently used in the analysis. This in no way invalidated the analysis – it is simply an observation considering the data provided relative to that anticipated.

Due to the nature of a PhD thesis, the research contained herein is naturally restricted, a limitation of it being that the PFS Model has not been applied to SME supply chains as a whole. Furthermore, international SME perspectives have not been considered. Whilst acknowledging these limitations, they provide the potential for future research opportunities.

A further limitation relates to the number of case study organisations that have been part of the study. Quite naturally there are limitations within any area of research, and PhD theses in particular face limitations due to the restrictions placed upon them. Such restrictions are a requirement of the process and assist in ensuring all requirements are met. They do though restrict the number of participating companies and interviewees partaking in the research. Along similar lines, the range of industries and sectors considered are naturally limited. The limitations for the adopted case study approach herein were discussed in the Methodology and Discussion chapters and are therefore not altogether new at this stage in the thesis. A point of interest here is that had the said limitations been removed, a changed methodology might have provided extended outcomes and a wider scope and depth to the study. This is something that could potentially be extended beyond this thesis.

8.7 Recommendations for Future Research

The success and limitations of the PFS Model at this stage provide some guidance for potential future research (illustrated in Figure 8. 1).

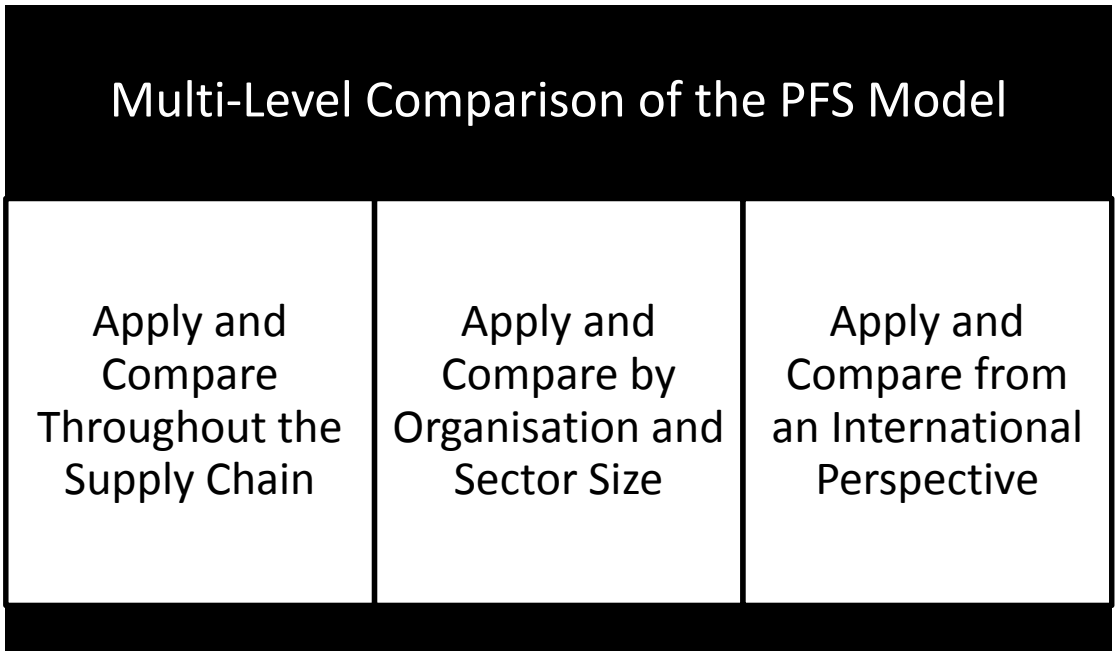


Figure 8. 1 – Model of Recommendations for Future Research (Author)

Arguably the most important point is to extend the research from the perspective of the supply chain as a whole, implementing the PFS Model therein. Measurement points might be based upon supply chain efficiency and effectiveness, improvements in communications as well as overall reduction in operating costs and ultimately profits. In the long-term, partnership duration might also be an area to monitor.

Beyond this point, it may be worthwhile considering details highlighted in Table 4. 1 (page 109), as future research may be developed in terms of more detailed consideration of the organisation size (relative to employee numbers) and the Business-to-Business or Business-to-Consumer status the organisation holds.

Furthermore, future research can consider the point highlighted in Section 3.8 Framework Model Limitations (page 98) whereby the basis of this study was highlighted as being founded upon UK-based data, and that subsequently inter-country generalisations cannot be made. In accepting this

argument, it is contended that the research be extended in the future to consider cross-country data, such that generalisations can be made for the PFS Model and its supporting models.

Having extended the research in this way there is rationale to considering the use of the PFS Model in larger (none-SME) organisations. This research has been exclusively based around SMEs with the intention of assisting in their supply chain development when competing in highly competitive markets. Rationally though, agility and agile supply chains will become more of a requirement for all organisations in the future, and the PFS Model may be in a position to assist therein.

The model might also be applied to SMEs in different countries to consider whether or not cultural factors impact upon its outputs. Furthermore, given that many SMEs build supply chains with other SMEs located internationally, the relevance of the model for such an opportunity is valid and necessary.

Further to suggestions based around Figure 8. 1, future research might also consider the use of the PFS Model aligned to organisational culture to ascertain if certain organisational social beliefs and norms assist agile supply chain development. Supporting this, psychological and behaviouristic models might be introduced into the PFS Model parameters, with the ultimate goal of assisting in behaviouristic as well as supply chain change to benefit agility. Furthermore, the model might be updated and aligned to live econometric (and other) data, enhancing the sharing and proliferation of information within the supply chain to consider the benefits or otherwise.

8.8 Concluding Remarks

This thesis has been written with the ultimate intention of developing a practical application for use in industry whilst at the same time providing consideration for future research. Its initial concept was considered whilst observing an inefficient supply chain system whilst working for an international organisation some time ago. Despite challenges throughout the process, it is hoped that the findings herein provide assistance to SMEs and that future research will emanate from it.

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10.0 Appendices

Appendix A

Interview Questionnaire

CONFIDENTIAL

Company name

Address

Contact

Contact name

Part 1: COMPANY PROFILE

Company name

Parent company _____ *(if applicable)*
_____
_____

Address **Tel**

Fax

City/Town **URL**

County **Post Code**

Contact name **Tel Direct**

Position **Email**

Please indicate the main business functions carried out in your company and the number of employees involved in each of the activities *(tick more than one if applicable)*

☐ Marketing [ ] ☐ Sales [ ]

☐ Procurement [ ] ☐ Distribution [ ]

☐ Product Development [ ] ☐ Manufacturing [ ]

☐ Customer Services [ ] ☐ Human Resource Management [ ]

Others _____ [ ]
_____
_____

		Approximate average of last three years	Current	Future three year figure or trend (2012-2014)
Annual turnover £M				
Market size £M				
Number of competitors				
Customers	**Number of customers**			
	New customers in existing market			
	New customers in new markets			
Number of main suppliers	**Market place**			
	Contractual			
	Partnership			
Number of products				
Number of new product introductions	**Extended product**			
	New product			

Part 2: THE MARKET

Can you identify your place in the Product Life Cycle?		Introduction Growth Maturity Decline
Can you clearly define your market for each product?		Yes No
Can you clearly define your corporate strategy?		Yes No
Customers – Who are the main customers?	**B2B**	
	B2C	
	End User	
Can you clearly define your marketing strategy for each product?		Yes No
Are you aware of potential obsolescence (including count-down timings of obsolescence) for all parts of your products?		Yes No
Please state estimated obsolescence time in months (this is the point at which a part or parts will need to be replaced on the product as a whole)		Months
Grade A,B,C,D according to your confidence (A being best) of technologies that will have a negative impact on your product		A B C D

What is the nature of competition for your product?	Local	Regional	National International
What is the intensity of competition for your product?	Low	Medium	High
Market Attractiveness			
How large is the potential market?	Low	Medium	High
How profitable is the potential market?	Low	Medium	High
How attractive (overall) is the market?	Low	Medium	High

Over the next 3-5 years are there any barriers that are likely to affect the growth of this product?	Availability of labour	Cost of Labour
	Availability of finance	Employment Regulations
	Managerial/leadership capability	Availability of suitable skill/ qualifications
	Environmental Regulations	Transport networks
	Ability to introduce organizational change	Intensity of competition
	Information & Communication Technology (ICT)	Suppliers/supply chain issues
	Other (please specify)	

Part 3: SUPPLIERS / SUPPLY CHAIN

Who are your suppliers?	For each product, can you clearly highlight your suppliers?	Yes No
Supplier relationship	Rate Supplier relationship - A, B,C (A being best)	A B C
	How many suppliers do you have?	
	Supplier issues – as a proportion of the suppliers, how many issues result (as a ratio)?	
	Do these issues usually come from the same supplier?	Yes No
Supplier communication	Do you have regular face to face meetings with suppliers?	Yes No
	Do you receive regular information updates from suppliers?	Yes No
	Is this information in electronic format?	Yes No
	Is this information in a format such that you can interpret it easily?	Yes No
	Is this information openly shared within the Supply Chain?	Yes No
What are your suppliers doing?	Are you aware of your suppliers' corporate strategy?	Yes No
	Are you aware of your suppliers' marketing strategy?	Yes No
	Would such information benefit your organisation?	Yes No
	How do you view the relationship with your suppliers for this product?	**Low priority** – suppliers only provide the material specified by us. **Medium priority** –suppliers can cooperate with us to support the change and improvement **High priority** – suppliers can often provide a basis for change and improvement

a) Yes b) No

If you had known the current supply chain situation in advance, would it have made a difference to your organisational growth strategy?		Yes No
If Yes, which of the following would have been different?	**a)** Different expected speed **b)** Different product range **c)** Different approach to achieve the growth **d)** Different growth objectives	

Your relationship with your suppliers. Please indicate the type of relationship you have with your suppliers

Contract Length	A	Individual Orders	Other Comments
	B	Less than 1 Year	
	C	1 - 3 Years	

	D	More than 4 Years or Product Life	
Trust	Low 0 1 2 3 High		Other Comments
Dependence	Low 0 1 2 3 High		Other Comments
Commitment	Low 0 1 2 3 High		Other Comments
Communication	Low 0 1 2 3 High		Other Comments
Information Share	Low 0 1 2 3 High		Other Comments
Cost Transparency	Low 0 1 2 3 High		Other Comments

Have there been any positive benefits resulting from working with suppliers on this product or range to:	Yes No	Introducing a new technology/knowledge to the company
	Yes No	Opening up a new marketplace
	Yes No	Opening up a new product range for the company
	Yes No	Improvement to achieve the design of the product for better [cost / quality / delivery / flexibility / performance / innovation]
	Yes No	Others
		Please briefly describe

	Do you believe your suppliers would respond favourably to closer strategic ties for mutual benefit (i.e. to reach high priority relationship status)?	Yes No	
	To date, do you benefit from organisations within the main capabilities in the design and production process?	Yes No	
	If YES, which of the following has your organisation benefited from?	Supplier	
		Customer	
		Distributor	
		Elsewhere in Supply Chain	
	What were the main benefits to your organisation?		

	When choosing a supplier, what are your organisation's main priorities?	Proximity	
		Cost	
		Quality	
		Ability to deliver	
		Relationship	
When you rethink the implementation of growth strategy of last time, what are the obstacles making the implementation of some objects unachieved or taking longer time to achieve? 1. Supply chain issues 2. Market issues 3. Internal capability 4. Others If supply chain is the one of the obstacles, could you describe in details			
Suppliers and the future	Are your suppliers aware of upcoming / future technologies that will affect ***their*** products?	Yes No	
	Are your suppliers actively building upcoming/new technologies into their upcoming products? Grade A, B or C (A being a positive and active role being taken)	A B C	
	Are your suppliers aware of upcoming/future technologies that could affect y***our*** products?	A B C	
	Are your suppliers actively supplying you with information regarding upcoming/new technologies for your future products [design]? Grade A, B or C (A being a positive and active role being taken)	A B C	
	Are your suppliers aware of potential benefits to them in supplying you with information regarding upcoming/new technologies that could be built into your products?	Yes No	
	Are your suppliers aware of potential obsolescence (including count-down timings of obsolescence) for all parts of y***our*** products?	Yes No	
	Do you believe the supply chain as a whole (with all inter-related knowledge) could act as a vehicle for the future development and sales for your products?	Yes No	
	Have you developed relationships within the supply chain regarding product development, design or production?	Yes No	
	If YES, Has this enhanced the organisation's ability to produce new / improved products?	Yes No	

	Which element of the business has improved?	Design	Yes No
		Production	Yes No
		Research	Yes No
		Quality	Yes No
		Delivery	Yes No
		Cost reduction	Yes No
		Efficiency	Yes No
		Profitability	Yes No
Does information flow transparently between your organisation and your suppliers?	Yes No		
Is the transparency one or two way?			
Is there any process integration between you and your main supplier?	Yes No		
If the answer is No, could any of the following explain the reason?	a) Lack of perception of process integration b) No incentive to carry on the process integration c) The relationship is not strong enough to carry on the process integration d) Do not know how to carry on the process integration		
What means of communication exists between your organisation and your suppliers?			
Do your suppliers know the end customer/consumer needs?			
Do you know your supplier(s) strategic goals?			
How confident are you of your supplier(s) knowledge of the market place? Grade A, B, C, D			
Does supplier quality always meet your requirements?			
Could your supplier compete with you (i.e. is the supplier a threat)?			
Does your supplier utilise lean production practices?			
Does your supplier make use of postponement?			
Supplier fill rate			

Supplier response delays			
Supplier Delivery - what % of deliveries arrive on-time?			
Supplier Partnerships - how many other partners does your supplier have?			
If you were to select suppliers for this product [to design/change or to promote to new markets], which of the following would be important in terms of your selection criteria? Please rank them.	**Important**	**Rank**	
			Cost (cheap)
			Quality
			Delivery
			Flexibility
			Willing to share risk
			Easy to work with or to cooperate (partnership)
			Trustworthy (from their history)
			Cost Transparency
			Technical support
			Technology Transfer (for design or production)
			Complementary company's capability
			Consultation for better approach to design or product
			Earlier involvement in product design

Do you think the strong relationship between members within supply chain could facilitate? a) The implementation of growth strategy b) Enhance and even shape the growth strategy c) A different approach to internal capability development d) Open up a new market	
What are the key factors to build up the strong relationship with members in supply chain? a) Open and effective communication b) Trust c) Commitment **d)** Process integration	
How do you perceive the contribution of supply chain to the growth strategy? Any example?	
How do you think the relationship among market requirement, the internal capability, and the supply chain issues?	
Supply chain issue could influence which part of following item of market negatively according to your experience? a) The market opportunities could not be caught because of lack of suitable suppliers or taking longer time to find the suitable suppliers b) The product profit could not be increased because of the uncompetitive material price from our suppliers. c) The market share could not be expanded because of the limited capability and cooperation of our suppliers. d) The competitive advantage could not be enhanced because of supply chain limitations.	

Part 4: VULNERABILITIES

What nodes in the SC are vulnerable?	Do you consider your organisational *vulnerability* from a strategic perspective? Yes No	
Transportation vulnerability?	In-house transportation vulnerability? Yes No	
Societal vulnerability	Trends indicating vulnerability? Yes No Social Needs that develop vulnerability for you? Yes No Bad press vulnerability? Yes No	
What technical vulnerability exists for your organisation?	How vulnerable are you to ***legal*** issues (as a %)?	
	How vulnerable are you to ***HRM*** issues (as a %)?	
	How vulnerable are you to ***personnel loss*** issues (as a %)?	
	How vulnerable are you to ***strikes*** (as a %)?	
	How vulnerable are you to ***accident*** issues (as a %)?	
	How vulnerable are you to ***criminal*** issues (as a %)?	
	How vulnerable are you to ***environmental*** issues (as a %)?	
	How vulnerable are you to ***energy issues*** (as a %)?	
	How vulnerable are you to ***demand shifts*** (as a %)?	
	How vulnerable are you to ***IT*** issues (as a %)?	
Exposure vulnerability? Financial, market, competition	Your financial exposure to banks (as a % of risk)	
	Your financial exposure to suppliers (as a % of risks)	
	Your financial exposure based on dependency on suppliers (as % of risk)	
	Your financial exposure to external economic changes e.g. the base rate (as % of risk)	
	Your exposure to B2B market trends (as a % of risk)	
	Your exposure to B2C market trends (as a % of risk)	
	Your exposure to end user market trends (as a % of risk)	
	Your exposure to market competition (as % of risk)	

Part 5: THE ENVIRONMENT

This section is concerned with the general business/economic environment and how the organisation interacts with it.

What proportion of product sales are for the home market?	
What proportion of product sales are for export?	
What proportion (%) of costs are attributable to exchange rates?	
Are **exchange rates** monitored regularly with production costs in mind?	
Are **exchange rates** monitored regularly with sales in mind?	
Does the organisation make use of bank loans / overdraft facilities?	
Does the organisation monitor financial institutions for the lowest borrowing rates?	
Is the organisation aware of and dealing with the added costs due to such borrowing?	
Does the organisation utilise 'free debt' via delayed payment to suppliers	
Does the organisation deal with delayed payments post sales?	
What does the organisation do regarding inflation of supplies – particularly in the current financial climate?	

Part 6: THE PRODUCT

This section is concerned with product features and their relative importance for both the product and by further implication, the organisation.

What are the main factors that have made this product so successful? Please tick each box that is applicable and also rank these where possible

	Yes/No	Rank
Product/process Innovation		
Product/process quality		
Resource advantage (Information, materials, location, human etc.)		
Management of the internal organization (operational planning, systems & procedure etc.)		
Finance (management of, sources of, favourability of exchange rate etc.)		
Human Resource Management (recruitment, training, reward, appraisal, team work, culture)		
Other (please specify)		
Market advantage (niche, competitive position, exporting)		
Statutory regulation		
Management of external organization (suppliers, customers, shareholders, partnerships)		
Transport networks (distribution/logistics etc.)		

In relation to this product specific, what are the drivers behind product development?

We tend to be a leader in product development and first to market with product	Yes / No
The product emerged reactionary to competitors' and we were forced to response	Yes / No
The product emerged as a direct reactionary result of a customers' requirement	Yes / No

What growth strategies are you currently pursuing for this product and how might these change in the future?

We are currently working to bring in new customers for this product (market development)	
We are currently pursuing development of the product for our existing customers (product development)	
How is this likely to change in the future?	

The following questions concern the Company's capability

How would you describe the technology used to produce this product?

Conventional	
Advanced	
Specialised	

What percentage of different source of the new technology in this product based on contribution to the product value?

R&D in house	%
Acquirement from market	%
Cooperation with supplier or customer	%

What are your company's main types of production (please tick)?

One off	
Small batch	
Large batch	
Continuous or mass	
Process mix (if so name it)	

How would you describe the required process for this product (please tick)?

Same machinery as previous products	
Required new machinery generally available	
Required new machinery specifically created for the product	
Required outsourcing part or all manufacturing	

How would you describe the material required for this product (please tick)?

Same material as previous products	
Required new material readily available for supply	
Required new material specifically created for this product	

How would you describe the staffs' skill needed to manufacture this product (please tick)?

Same skill as previous products	
General skill training improvement required	
Specific skill training for this product required	

Has there been any new design change to this product?

☐ Yes ☐ No

In the original design process of this product, how do you describe the design capability (please tick)?

All designed in house	
Some specialised parts designed by supplier according to company's requirement	
Some specialised parts designed by the cooperation between company and suppliers	

Some new features were based on the supplier's new product (not specified by company)	

How would you describe your new product design process based on your latest design of this product (please tick)?

Well-managed in a structured process	
Training needed for members of design team	
A structured process needed	

With respect to production, which of following best describes the real situation?

☐ All made in house ☐ Outsourcing some parts ☐ Outsourcing all parts

If the answer is outsourcing some parts, could the percentage of outsourcing be given: [%]

Which of following capabilities created barriers for the success of this product (please tick)?

Marketing research management	
Production operation	
Product design management	
Human resource management	
Supply chain management	
Others (please specify)	

Which of following capabilities have facilitated the success of this product (please tick)?

Product design	
Production process	
Management	
R&D	
Supply chain management	
Others (please specify)	

In the latest product design for this product, did the company's capability match the original proposed product features (please tick)?

Yes	
No	

If the answer is no,
a. please describe what kind of product features were dropped and based on what principles:

b. please describe what kinds of new capabilities were needed and how were these capabilities attained:

Part two: Product selection procedure and product feature classification

Key principles for product selection

1. **Turnover contribution to company**
2. **Growth potential**
3. **The complexity of product:**
   - **Product design and product process**
   - **Number of components, suppliers,**
   - **Technology operations**
   - **Marketing**

	Product Name	% Contribution to Organisational Turnover	Position in Product Life Cycle (Select one option)	Potential for Growth High, Medium, Low	Complexity (E.g. Design, Operations, No of Parts, Marketing etc.) High Medium Low
A			Introduction, Growth, Maturity, Decline		
B			Introduction, Growth, Maturity, Decline		
C			Introduction, Growth, Maturity, Decline		
D			Introduction, Growth, Maturity, Decline		

What are the main features for PRODUCT A?

Feature 1:_____

Feature 2:_____

Feature 3:_____

Please provide Feature Variations relative to each other in the following table:

Feature 1	Feature 2	Feature 3	4	5	6	Ranking of Combinations

Question: Specify features, then identify the relevant characteristics. Comment that how and when these features were considered in the product design process

Feature 1

	Product Features	**Feature 1**			**Comments**
	Feature Characteristics			Ranking	
Drivers	**Cost**	W	Q		
	Delivery	W	Q		
	Quality	W	Q		
	Performance	W	Q		
	Innovation	W	Q		
	Flexibility	W	Q		
	Service	W	Q		
	Market	W	Q		
Supply Chain	**Outsourcing (Y/N)**				
	Supplier (within market place)				
	Supplier Specialist				
	Supplier Involvement				

W: Order Winner Q: Order Qualifier Blank: Low Importance

Feature 2

	Product Features	Feature 2		Comments
	Feature Characteristics			
Drivers	**Cost**	W	Q	
	Delivery	W	Q	
	Quality	W	Q	
	Performance	W	Q	
	Innovation	W	Q	
	Flexibility	W	Q	
	Service	W	Q	
	Market	W	Q	
Supply Chain	**Outsourcing (Y/N)**			
	Supplier (within market place)			
	Supplier Specialist			
	Supplier Involvement			

Feature 3

	Product Features	Feature 3		Comments
	Feature Characteristics			
Drivers	**Cost**	W	Q	
	Delivery	W	Q	
	Quality	W	Q	
	Performance	W	Q	
	Innovation	W	Q	
	Flexibility	W	Q	
	Service	W	Q	
	Market	W	Q	
Supply Chain	**Outsourcing (Y/N)**			
	Supplier (within market place)			
	Supplier Specialist			
	Supplier Involvement			

Repertory Grid Questionnaire – PRODUCT A

Enter Key Product Features from Conjoint Analysis	**Enter Attractiveness to host Organisation** **L / M / H** **Cost**	**Enter Attractiveness to host Organisation** **L / M / H** **Time**	**Enter Attractiveness to host Organisation** **L / M / H** **Effort**	**Enter Attractiveness to host Organisation** **L / M / H** **Company Strength / Weakness?**	**Enter Attractiveness to host Organisation** **L / M / H** **Ability to Deliver / Capability**	**Enter Attractiveness to host Organisation** **L / M / H** **Quality**	**Enter Attractiveness to host Organisation** **L / M / H** **Performance**	**Enter Attractiveness to host Organisation** **L / M / H** **Innovation**	**Enter Attractiveness to host Organisation** **L / M / H** **Flexibility**	**Enter Attractiveness to host Organisation** **L / M / H** **Service**

Repertory Grid Questionnaire – PRODUCT B

Enter Key Product Features from Conjoint Analysis	Enter Attractiveness to host Organisation L / M / H Cost	Enter Attractiveness to host Organisation L / M / H Time	Enter Attractiveness to host Organisation L / M / H Effort	Enter Attractiveness to host Organisation L / M / H Company Strength / Weakness?	Enter Attractiveness to host Organisation L / M / H Ability to Deliver / Capability	Enter Attractiveness to host Organisation L / M / H Quality	Enter Attractiveness to host Organisation L / M / H Performance	Enter Attractiveness to host Organisation L / M / H Innovation	Enter Attractiveness to host Organisation L / M / H Flexibility	Enter Attractiveness to host Organisation L / M / H Service

Repertory Grid Questionnaire – PRODUCT C

Enter Key Product Features from Conjoint Analysis	Enter Attractiveness to host Organisation L / M / H Cost	Enter Attractiveness to host Organisation L / M / H Time	Enter Attractiveness to host Organisation L / M / H Effort	Enter Attractiveness to host Organisation L / M / H Company Strength / Weakness?	Enter Attractiveness to host Organisation L / M / H Ability to Deliver / Capability	Enter Attractiveness to host Organisation L / M / H Quality	Enter Attractiveness to host Organisation L / M / H Performance	Enter Attractiveness to host Organisation L / M / H Innovation	Enter Attractiveness to host Organisation L / M / H Flexibility	Enter Attractiveness to host Organisation L / M / H Service

Repertory Grid Questionnaire – PRODUCT D

Enter Key Product Features from Conjoint Analysis	**Enter Attractiveness to host Organisation** **L / M / H** **Cost**	**Enter Attractiveness to host Organisation** **L / M / H** **Time**	**Enter Attractiveness to host Organisation** **L / M / H** **Effort**	**Enter Attractiveness to host Organisation** **L / M / H** **Company Capability**	**Enter Attractiveness to host Organisation** **L / M / H** **Ability / Capability to Deliver**	**Enter Attractiveness to host Organisation** **L / M / H** **Quality**	**Enter Attractiveness to host Organisation** **L / M / H** **Performance**	**Enter Attractiveness to host Organisation** **L / M / H** **Innovation**	**Enter Attractiveness to host Organisation** **L / M / H** **Flexibility**	**Enter Attractiveness to host Organisation** **L / M / H** **Service**

Appendix B - Spreadsheet Formulae Used in Conjoint and Repertory Grid Analysis

Total Average Desirability Score of Feature		Total Average Desirability Score of Feature		Total Average Desirability Score of Feature		Relative Importance of Each Feature Dimension	
X	=SUM($U$15/$U$4)	Red	=SUM(U19/U8)	5mm	=SUM(U23/U12)	A	=SUM(U29/U39)
Y	=SUM($U$16/$U$5)	Blue	=SUM(U20/U9)	10mm	=SUM(U24/U13)	B	=SUM(U33/U39)
Z	=SUM($U$17/$U$6)	Green	=SUM(U21/U10)			C	=SUM(U37/U39)

Figure 10. 1 - Conjoint Analysis – Desirability of Features and Importance of Feature Dimensions Formulae (Author)

=COUNTIF($A:$A,"x")	X Count
=COUNTIF($A:$A,"Y")	Y Count
=COUNTIF($A:$A,"Z")	Z Count
=COUNTIF($B:$B,"Red")	Red Count
=COUNTIF($B:$B,"Blue")	Blue Count
=COUNTIF($B:$B,"Green")	Green Count
=COUNTIF($C:$C,"5mm")	5mm Count
=COUNTIF($C:$C,"10mm")	10mm Count
=SUMIF($A:$A,"X",$K:$K)	Total of X Values
=SUMIF($A:$A,"Y",$K:$K)	Total of Y Values
=SUMIF($A:$A,"Z",$K:$K)	Total of Z Values
=SUMIF($B:$B,"Red",$K:$K)	Total of Red Values
=SUMIF($B:$B,"Blue",$K:$K)	Total of Blue Values
=SUMIF($B:$B,"Green",$K:$K)	Total of Green Values
=SUMIF($C:$C,"5mm",$K:$K)	Total of 5mm Values
=SUMIF($C:$C,"10mm",$K:$K)	Total of 10mm Values
=MIN(($D$22:$D$24,$E$22:$E$24))	Low range of Average Score for A
=MAX(($D$22:$D$24,$E$22:$E$24))	Max range of Average Score for A
=SUM(U28-U27)	RANGE SCORE
=MIN(($F$22:$F$24,$G$22:$G$24))	Low range of Average Score for B
=MAX(($F$22:$F$22,$G$22:$G$24))	Max range of Average Score for B
=SUM(U32-U31)	RANGE SCORE
=MIN(($H$22:$H$24,$I$22:$I$24))	Low range of Average Score for C
=MAX(($H$22:$H$24,$I$22:$I$24))	Max range of Average Score for C
=SUM(U36-U35)	RANGE SCORE
=SUM(U29+U33+U37)	Total Range Score
=MEDIAN(K3:K11)	Mid-point in range

Figure 10. 2 - Conjoint Analysis and Count Range Formulae (Author)

	Cost	Time	Effort	Company Strength / Weakness? Ability to Deliver / Capability	Quality	Performance	Innovation	Flexibility	Service	Capability / Attractivenss to Company	
=+'Product Features'!$B$3	l	l	l	l	l	l	l	l	l	l	**=SUM(AG4:AU4)**	=RANK(M
=+'Product Features'!B4	l	l	l	h	h	h	h	h	h	h	**=SUM(AG5:AU5)**	=RANK(M
=+'Product Features'!B5	l	l	m	h	l	l	l	l	l	l	**=SUM(AG6:AU6)**	=RANK(M
=+'Product Features'!B6	l	l	m	h	l	l	l	l	l	l	**=SUM(AG7:AU7)**	=RANK(M
=+'Product Features'!$B$7	m	h	h	h	m	m	m	m	m	m	**=SUM(AG8:AU8)**	=RANK(M
=+'Product Features'!$B$8	l	h	h	h	l	l	l	l	l	l	**=SUM(AG9:AU9)**	=RANK(M
=+'Product Features'!$B$9	l	l	l	h	l	l	l	l	l	l	**=SUM(AG10:AU10)**	=RANK(M
=+'Product Features'!$B$10	l	l	l	h	l	l	l	l	l	l	**=SUM(AG11:AU11)**	=RANK(M

Figure 10. 3 - Repertory Grid Analysis – Rating and Ranking Formulae Part 1 (Author)

ractivenss to Company	Ranking of Capability/Attractiveness to Company	Do we Need to Outsource?	Supplier - E (Exists), D(Does not exist), P (Partner Supplier), k (Do not know)?	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required	Supplier Interest / Commitment Level	Supplier Capability?	TOTAL VALUE
=RANK(M4, $M$4:$M$1	y	e	h	h	h	l	h	=SUM(AG4:AU4)	
=RANK(M5, $M$4:$M$1	y	k	l	l	h	l	h	=SUM(AG5:AU5)	
=RANK(M6, $M$4:$M$1	y	d	l	l	h	l	h	=SUM(AG6:AU6)	
=RANK(M7, $M$4:$M$1	y	d	l	l	h	l	h	=SUM(AG7:AU7)	
=RANK(M8, $M$4:$M$1	y	p	m	m	h	l	h	=SUM(AG8:AU8)	
=RANK(M9, $M$4:$M$1	n	e	l	l	h	l	h	=SUM(AG9:AU9)	
=RANK(M10, $M$4:M	n	e	l	l	h	l	h	=SUM(AG10:AU10)	
=RANK(M11, $M$4:M	n	k	l	l	h	l	h	=SUM(AG11:AU11)	

Figure 10. 4 - Repertory Grid Analysis – Rating and Ranking Formulae Part 2 (Author)

Cost Lookup Value	Time Lookup	Effort Lookup
=VLOOKUP(C4, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D4, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E4, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C5, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D5, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E5, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C6, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D6, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E6, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C7, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D7, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E7, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C8, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D8, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E8, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C9, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D9, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E9, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C10, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D10, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E10, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C11, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D11, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E11, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C12, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D12, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E12, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)
=VLOOKUP(C13, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$6)	=VLOOKUP(D13, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$7)	=VLOOKUP(E13, $BE$10:$BF$12, 2, FALSE)*('Rating Sheet'!$D$8)

Figure 10. 5 - Repertory Grid Analysis Spreadsheet Lookup Tables (1) Formulae (Author)

Company Strength / Weakness Lookup	Ability to Deliver	Quality
=VLOOKUP(F4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$10)	=VLOOKUP(H12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)
=VLOOKUP(F13, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$9)	=VLOOKUP(G13, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(H13, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$11)

Figure 10. 6 - Repertory Grid Analysis Spreadsheet Lookup Tables (2) Formulae (Author)

Performance	Innovation	Flexibility
=VLOOKUP(I4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K4, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K5, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K6, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K7, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K8, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K9, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K10, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K11, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K12, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)
=VLOOKUP(I13, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$12)	=VLOOKUP(J13, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$13)	=VLOOKUP(K13, $BE$3:$BF$5, 2, FALSE)*('Rating Sheet'!$D$14)

Figure 10. 7 - Repertory Grid Analysis Spreadsheet Lookup Tables (3) Formulae (Author)

Supplier - E (Exists), D(Does not exist), P (Partner Supplier), k (Do not know)?	Supplier Specialist	Supplier Involvement in Product Development?	Amount of Supplier Time / Input Required
=VLOOKUP(P4, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q4, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R4, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S4, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P5, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q5, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R5, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S5, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P6, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q6, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R6, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S6, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P7, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q7, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R7, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S7, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P8, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q8, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R8, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S8, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P9, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q9, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R9, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S9, $BE$10:$BF$12, 2, FALSE)
=VLOOKUP(P10, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q10, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R10, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S10, $BE$10:$BF$12, 2, FALSE
=VLOOKUP(P11, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q11, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R11, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S11, $BE$10:$BF$12, 2, FALSE
=VLOOKUP(P12, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q12, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R12, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S12, $BE$10:$BF$12, 2, FALSE
=VLOOKUP(P13, $BE$31:$BF$34, 2, FALSE)	=VLOOKUP(Q13, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(R13, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(S13, $BE$10:$BF$12, 2, FALSE

Figure 10. 8 - Repertory Grid Analysis Spreadsheet Lookup Tables (4) Formulae (Author)

Supplier Interest / Commitment Level	Supplier Capability?	Supplier Strength	Attractiveness To Supplier
=VLOOKUP(T4, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U4, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V4, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB4, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T5, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U5, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V5, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB5, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T6, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U6, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V6, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB6, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T7, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U7, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V7, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB7, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T8, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U8, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V8, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB8, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T9, $BE$10:$BF$12, 2, FALSE)	=VLOOKUP(U9, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V9, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB9, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T10, $BE$10:$BF$12, 2, FALSE	=VLOOKUP(U10, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V10, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB10, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T11, $BE$10:$BF$12, 2, FALSE	=VLOOKUP(U11, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V11, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB11, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T12, $BE$10:$BF$12, 2, FALSE	=VLOOKUP(U12, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V12, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB12, $BE$3:$BF$5, 2, FALSE)
=VLOOKUP(T13, $BE$10:$BF$12, 2, FALSE	=VLOOKUP(U13, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(V13, $BE$3:$BF$5, 2, FALSE)	=VLOOKUP(AB13, $BE$3:$BF$5, 2, FALSE)

Figure 10. 9 - Repertory Grid Analysis Spreadsheet Lookup Tables (5) Formulae (Author)

=+'Product Features'!B3	a	=VLOOKUP($B$21, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B4	a	=VLOOKUP($B$22, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B5	a	=VLOOKUP($B$23, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B6	b	=VLOOKUP($B$24, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B7	b	=VLOOKUP($B$25, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B8	b	=VLOOKUP($B$26, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B9	c	=VLOOKUP($B$27, $BE$21:$BF$28, 2, FALSE)
=+'Product Features'!B10	c	=VLOOKUP($B$28, $BE$21:$BF$28, 2, FALSE)
e	3	Lookup table for P3
d	0	Supplier - E (Exists), D(Does not exist), P (Partner Suppli
p	5	
k	1	
Y	1	For Question "Do we need to outsource?"
N	5	

Figure 10. 10 - Repertory Grid Analysis Spreadsheet Lookup Tables (6) Formulae (Author)

		Market Desirability Score from Conjoint Analysis (Out of 10)	Relative Importance of Feature Dimension from Conjoint Analysis	Supplier - E (Exists), D(Does not exist), P (Partner Supplier), K (Do not know)	Supplier Capability for Project	Supplier Interest / Commitment Level	Project Attractiveness To Supplier	Overall ATTRACTIVENESS TO COMPANY
='Product Features'!$B$3	=+N4	='Conjoint Analysis'!$E$22	=VLOOKUP(BG21, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS4	=+AX4	=+AW4	=+BB4	=SUM(C21+D21+E21+G21+H21+I21+J21)
='Product Features'!$B$4	=+N5	='Conjoint Analysis'!$E$23	=VLOOKUP(BG22, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS5	=+AX5	=+AW5	=+BB5	=SUM(C22+D22+E22+G22+H22+I22+J22)
='Product Features'!$B$5	=+N6	='Conjoint Analysis'!$E$24	=VLOOKUP(BG23, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS6	=+AX6	=+AW6	=+BB6	=SUM(C23+D23+E23+G23+H23+I23+J23)
='Product Features'!$B$6	=+N7	='Conjoint Analysis'!$G$22	=VLOOKUP(BG24, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS7	=+AX7	=+AW7	=+BB7	=SUM(C24+D24+E24+G24+H24+I24+J24)
='Product Features'!$B$7	=+N8	='Conjoint Analysis'!$G$23	=VLOOKUP(BG25, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS8	=+AX8	=+AW8	=+BB8	=SUM(C25+D25+E25+G25+H25+I25+J25)
='Product Features'!$B$8	=+N9	='Conjoint Analysis'!$G$24	=VLOOKUP(BG26, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS9	=+AX9	=+AW9	=+BB9	=SUM(C26+D26+E26+G26+H26+I26+J26)
='Product Features'!$B$9	=+N10	='Conjoint Analysis'!$I$22	=VLOOKUP(BG27, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS10	=+AX10	=+AW10	=+BB10	=SUM(C27+D27+E27+G27+H27+I27+J27)
='Product Features'!$B$10	=+N11	='Conjoint Analysis'!$I$23	=VLOOKUP(BG28, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS11	=+AX11	=+AW11	=+BB11	=SUM(C28+D28+E28+G28+H28+I28+J28)
='Product Features'!$B$11	=+N12		=VLOOKUP(BG29, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS12	=+AX12	=+AW12	=+BB12	=SUM(C29+D29+E29+G29+H29+I29+J29)
='Product Features'!$B$12	=+N13		=VLOOKUP(BG30, 'Conjoint Analysis'!$J$22:$K$24, 2, FALSE)	=+AS13	=+AX13	=+AW13	=+BB13	=SUM(C30+D30+E30+G30+H30+I30+J30)

Figure 10. 11 - Repertory Grid Analysis – Formulae showing links to Conjoint Analysis, Relative Importance of Feature Dimensions from Conjoint Analysis and Overall Attractiveness to Organisation (Author)